

Vol. I

173-244

SC

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1938

No. 3

**THE SCHRIBER-SCHROTH COMPANY,
PETITIONER,**

vs.

**THE CLEVELAND TRUST COMPANY, CHRYSLER
CORPORATION.**

No. 4

**THE ABERDEEN MOTOR SUPPLY COMPANY,
PETITIONER,**

vs.

**THE CLEVELAND TRUST COMPANY, CHRYSLER
CORPORATION.**

No. 5

THE F. E. ROWE SALES COMPANY, PETITIONER,

vs.

**THE CLEVELAND TRUST COMPANY, CHRYSLER
CORPORATION.**

**ON WRITS OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT
OF APPEALS FOR THE SIXTH CIRCUIT.**

PETITION FOR CERTIORARI FILED JANUARY 7, 1938.

CERTIORARI GRANTED MAY 31, 1938.

United States Circuit Court of Appeals
FOR THE SEVENTH CIRCUIT.

THE CLEVELAND TRUST COMPANY,
CREDITORS COMPANY,
Plaintiffs-Appellants,

vs.

THE SOUTHERN-SCHWAB COMPANY,
Defendant-Appellee.

No. 4045.
EQUITY.

THE CLEVELAND TRUST COMPANY,
CREDITORS COMPANY,
Plaintiffs-Appellants,

vs.

THE AMERICAN MORGAN SUGAR COMPANY,
Defendant-Appellee.

No. 4046.
EQUITY.

THE CLEVELAND TRUST COMPANY,
CREDITORS COMPANY,
Plaintiffs-Appellants,

vs.

THE F. H. ROSS SUGAR COMPANY,
Defendant-Appellee.

No. 4047.
EQUITY.

THE SOUTHERN-SCHWAB COMPANY,
FOR THE DEFENSE OF THE SEVENTH CIRCUIT,
COUNSEL FOR THE DEFENSE.

THE SOUTHERN-SCHWAB COMPANY,

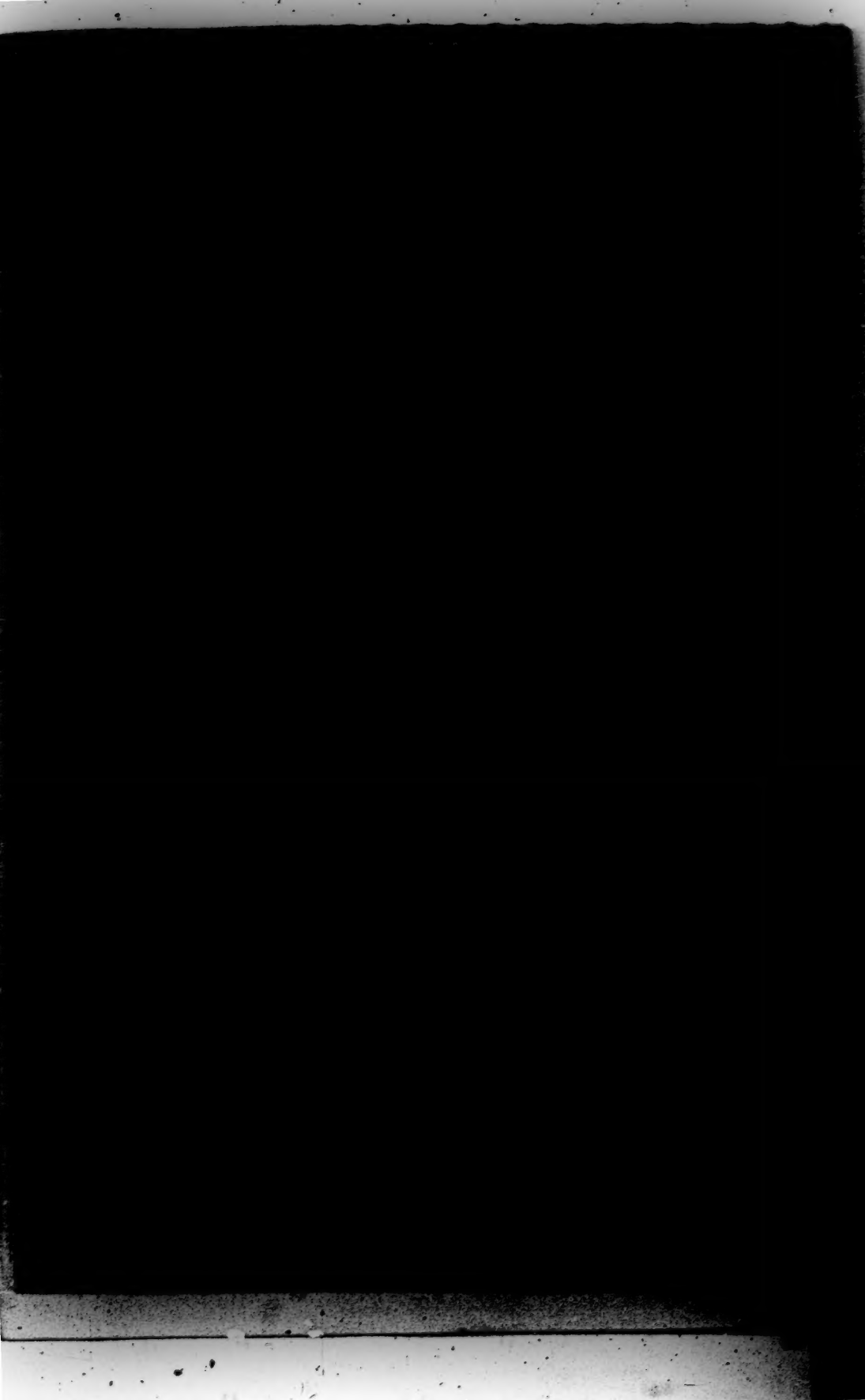
JOHN H. ROSS, Plaintiff-Appellant,
vs. THE SOUTHERN-SCHWAB COMPANY,

THE SOUTHERN-SCHWAB COMPANY,

THE SOUTHERN-SCHWAB COMPANY,
Plaintiffs-Appellants.

THE SOUTHERN-SCHWAB COMPANY,

THE SOUTHERN-SCHWAB COMPANY,
Plaintiffs-Appellants.



United States Circuit Court of Appeals

FOR THE SIXTH CIRCUIT.

THE CLEVELAND TRUST COMPANY,
CHRYSLER CORPORATION,
Plaintiffs-Appellants,

vs.

THE SCHRIEBER-SCHROTH COMPANY,
Defendant-Appellee.

No. 4045.
EQUITY.

THE CLEVELAND TRUST COMPANY,
CHRYSLER CORPORATION,
Plaintiffs-Appellants,

vs.

THE ABERDEEN MOTOR SUPPLY COMPANY,
Defendant-Appellee.

No. 4046.
EQUITY.

THE CLEVELAND TRUST COMPANY,
CHRYSLER CORPORATION,
Plaintiffs-Appellants,

vs.

THE F. E. ROWE SALES COMPANY,
Defendant-Appellee.

No. 4047.
EQUITY.

APPEALS FROM
THE DISTRICT COURT OF THE UNITED STATES,
FOR THE NORTHERN DISTRICT OF OHIO,
EASTERN DIVISION.

TRANSCRIPT OF RECORD VOLUME I

Trial Papers, Plaintiffs' Testimony in Chief
and Defendants' Testimony in Chief.

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CAPTION.

[Case No. 4045.]

UNITED STATES OF AMERICA,
NORTHERN DISTRICT OF OHIO,
EASTERN DIVISION, ss.

Record of the proceedings of the District Court of the United States within and for the Eastern Division of the Northern District of Ohio, in the causes and matters hereinafter stated, the same being finally disposed of at a regular term of said court begun and held at the City of Cleveland, in said district, on the first Tuesday in April, being the third day of said month, in the year of our Lord one thousand nine hundred and thirty-four and in the one hundred and fifty-eighth year of the Independence of the United States of America, to-wit, on Friday, the 27th day of July, A. D. 1934.

Honorable PAUL JONES,
United States District Judge.

THE CLEVELAND TRUST COMPANY,
CHRYSLER CORPORATION,

VS.

No. 4045 EQUITY.

THE SCHRIEBER-SCHROTH COMPANY.

Said action was commenced on the 17th day of October, A. D. 1931 and proceeded to final disposition at the term and day above written and during the progress thereof pleadings and papers were filed, process was issued and returned and orders of the court were made and entered in the order and on the dates hereinafter stated, to-wit:

ORIGINAL BILL OF COMPLAINT.

(Filed October 17, 1931.)

[Case No. 4045.]

To the Honorable Judges of the United States District Court for the Northern District of Ohio, Eastern Division:

Plaintiffs, for their Bill of Complaint, allege:

1.

That Plaintiff, The Cleveland Trust Company, is a corporation organized and existing under the laws of the State of Ohio, having its principal place of business at Cleveland, State of Ohio.

That Plaintiff, Chrysler Corporation, is a corporation organized and existing under the laws of the State of Delaware, having its principal place of business at Highland Park, State of Michigan.

2.

That Defendant, The Schriber-Schroth Company of Akron, Ohio, is a corporation organized and existing under the laws of the State of Ohio and is a citizen and inhabitant thereof, having a regular and established place of business at 61 West Market Street, Akron, County of Summit and State of Ohio.

That Defendant, Sterling Products Corporation of St. Louis, Missouri, is a corporation duly organized and existing under the laws of the State of Missouri and has a regular and established place of business at 2914 North Market Street in the City of St. Louis, County of St. Louis, and State of Missouri.

3.

This suit is brought under the present laws of the United States, and seeks injunctive and other relief against the defendants and each of them for infringements and contributory infringements committed by each and both defendants within this Judicial District and elsewhere within the United States.

4.

That heretofore and prior to the 2nd day of June, 1917, Louis P. Mooers, a citizen of the United States, then residing at Cincinnati, Hamilton County, State of

Ohio, was the original, first and true inventor of certain new and useful improvements in Pistons for Internal Combustion Motors, fully described in Letters Patent of the United States No. 1,402,309, hereinafter mentioned, which invention or improvement was not known or used by others in this country or patented or described in any printed publication in this or any foreign country, prior to his invention thereof, or more than two years prior to his application for said Letters Patent; had not been in public use or on sale in this country for more than two years prior to said application; had not been abandoned to the public, and had not been patented or caused to be patented by him or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to the filing of his application for Letters Patent of the United States therefor; that the said Louis P. Mooers made due application to the Commissioner of Patents of the United States in accordance with the then existing Acts of Congress, for Letters Patent of the United States for said invention and improvement.

5.

That by an instrument in writing duly executed and delivered by said Louis P. Mooers and duly recorded in the United States Patent Office in Liber P-103, page 133 of the Transfers of Patents, said Louis P. Mooers assigned an undivided half of the entire right, title and interest in, and to said invention and improvement and in and to said application for Letters Patent to George B. Pitts of Cleveland, Ohio and authorized and requested the Commissioner of Patents to issue the Letters Patent upon said application and for said invention and improvement to said George B. Pitts and Louis P. Mooers; and by said instruments in writing specified in Article 3 of this Bill as recorded in Liber Q-107, pages 336 and 339 of the Transfers of Patents, said George B. Pitts and Louis P. Mooers respectively each assigned his undivided one-half of the entire right, title and interest in, to and under said Letters Patent of the United States No. 1,402,309 to your Orator, The Cleveland Trust Company, and authorized and requested the Commissioner of Patents to issue the Letters Patent upon said application and for said invention and improvement to said The Cleveland Trust Company; whereby your Orator became vested with and holds the entire right, title and in-

terest in, to and under said Letters Patent No. 1,402,309, as will more fully and at large appear upon production in Court of the said Letters Patent and the assignments aforesaid.

6.

That heretofore and prior to the 14th day of July, 1917, Victor E. Schmiedeknecht, a citizen of the United States then residing at Louisville in the County of Jefferson and State of Kentucky, was the first and true inventor of certain new and useful improvements in Pistons; fully described in Letters Patent of the United States No. 1,256,265, hereinafter mentioned, which invention and improvement was not known or used by others in this country, or patented or described in any printed publication in this or any foreign country, prior to his invention thereof, or more than two years prior to his application for said Letters Patent; had not been in public use or on sale in this country for more than two years prior to said application; had not been abandoned to the public, and had not been patented or caused to be patented by him or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to the filing of his application for Letters Patent of the United States therefor; that the said Victor E. Schmiedeknecht made due application to the Commissioner of Patents of the United States in accordance with the then existing Acts of Congress, for Letters Patent of the United States for said invention and improvement, and having in all respects complied with the conditions and requirements of said Acts of Congress, on the 12th day of February, 1918, Letters Patent of the United States No. 1,256,265, signed, sealed and executed in due form of law for the said invention or improvement, were issued and delivered unto said Victor E. Schmiedeknecht, his successors and assigns, for the term of seventeen years from said 12th day of February, 1918, the sole and exclusive right to make, use and sell to others to be used, throughout the United States and the territories thereof, the aforesaid invention or improvement, all as by said Letters Patent or a duly authenticated copy thereof in Court to be produced and shown to Your Honors will more fully and at large appear.

7.

That subsequent to the granting of the aforesaid Letters Patent No. 1,256,265, by an instrument in writing that was duly recorded in the United States Patent Office on or about the 16th day of August, 1927 in Liber F-131, page 79 of the Transfers of Patents, said Victor E. Schmiedeknecht assigned the entire right, title and interest in, to and under said Letters Patent of the United States No. 1,256,265, together with the right to sue for, collect, and retain damages and profits for past infringement under said Letters Patent to one Frank Kent of New York City; and, whereas this assignment was further amplified by further warranty and guarantee that was also recorded in the United States Patent Office on or about the 16th day of August, 1927 in Liber P-131, page 81 of the Transfers of Patents; whereby said Frank Kent, his successors and assigns, became vested with the entire right, title and interest in, to and under said Letters Patent of the United States No. 1,256,265, together with the right to sue for, collect, and retain damages and profits for past infringements of said Letters Patent.

8.

That by an instrument in writing dated October 12, 1927 and duly recorded in the United States Patent Office in the Transfers of Patents, said Frank Kent assigned the entire right, title and interest in, to and under said Letters Patent of the United States, together with the right to sue, collect, and retain damages and profits for past infringement, to Bohn Aluminum & Brass Corporation of Detroit, Michigan, its successors and assigns.

9.

That said Bohn Aluminum & Brass Corporation, by an instrument in writing dated on or about October 31st, 1927, and recorded in the United States Patent Office in Liber C-133, page 618 of the Transfers of Patents, assigned to Your Orator, The Cleveland Trust Company, its successors and assigns, the entire right, title and interest in, to and under said Letters Patent, together with the right to sue for, collect and retain damages and profits for past infringements of said Letters Patent; whereby plaintiff, The Cleveland Trust Company, became vested with and now holds the entire right, title and interest in, to and under the aforesaid Letters Patent No. 1,256,265,

and the right to sue for, collect, and retain damages and profits for past infringement of said Letters Patent, as will more fully and at large appear upon production in this Court of the assignments aforesaid or duly authenticated copies thereof.

10.

That heretofore, and prior to the third day of January, 1921, Howard E. Maynard, then residing at Detroit, in the County of Wayne and State of Michigan, was the original, first and true inventor of certain new and useful improvements in Pistons fully described in Letters Patent of the United States No. 1,655,968 hereinafter mentioned, which invention or improvement was not known or used by others in this country, or patented or described in any printed publication in this or any foreign country before his said invention or discovery thereof, or more than two years prior to his application for Letters Patent therefor, and had not been in public use or on sale in this country for more than two years prior to his application for Letters Patent therefor; and had not been patented or caused to be patented by him or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to the filing of the application for Letters Patent thereon in this country.

11.

That the said Howard E. Maynard, being as aforesaid, the inventor of the said improvement, made application to the Commissioner of Patents of the United States for Letters Patent in accordance with the then existing Acts of Congress, and, having in all respects complied with the conditions and requirements of said Acts of Congress, on the tenth day of January, 1928 Letters Patent of the United States numbered 1,655,968, signed, sealed and executed in due form of law, for the said invention or improvement, were issued to said Chrysler Corporation, a corporation of Delaware, at Highland Park, Michigan, plaintiff, and Aluminum Company of America, a corporation of Pennsylvania, at Pittsburgh, Pa., as assignees each of one-half of the entire right, title and interest in and to said Letters Patent, whereby there was secured to Chrysler Corporation and Aluminum Company of America for the term of seventeen years from the tenth day of January, 1928, the sole and

exclusive right to make, use and sell to others to be used throughout the United States and the territories thereof, the aforesaid invention or improvement, all as by said Letters Patent, or a duly authenticated copy thereof here in Court to be produced and shown unto Your Honors, as will more fully and at large appear.

12.

That prior to the filing of this Bill of Complaint, said Aluminum Company of America, by an instrument in writing dated February 23, 1928 and recorded in the Transfers of Patents in the United States Patent Office as of May 12, 1930 in Liber Z-143, page 283, assigned its undivided one-half interest in the entire right, title and interest in and to said Letters Patent No. 1,655,968 to The Cleveland Trust Company, plaintiff herein, together with the right to sue for and recover damages for past infringements of said Letters Patent, whereby your plaintiff, The Cleveland Trust Company, became vested with and now holds an undivided one-half interest in the entire right, title and interest in, to, and under said Letters Patent No. 1,655,968, as will more fully and at large appear upon production in Court of the assignments aforesaid.

13.

That the plaintiff, Chrysler Corporation, is a non-resident and resides without the jurisdiction of this Court and therefore cannot be served with process and made a co-defendant in this cause, and that plaintiff, The Cleveland Trust Company, has advised Chrysler Corporation of the imminent pendency of this case and of the obligation of Chrysler Corporation to join voluntarily in the bringing of this suit, but that Chrysler Corporation has refused or declined to so voluntarily join and that the plaintiff, The Cleveland Trust Company, is without remedy on the Maynard patent unless Chrysler Corporation is joined as a co-plaintiff in this cause, and therefore to prevent a failure of justice and to enable The Cleveland Trust Company to protect its interests herein, the Chrysler Corporation is made a plaintiff herein without its consent.

14.

That heretofore and prior to the 11th day of March, 1920, Frank Jardine, a citizen of the United States, then

residing at Cleveland, in the County of Cuyahoga and State of Ohio, was the original, first and true inventor of certain new and useful improvements in Pistons, fully described in Letters Patent of the United States No. 1,763,523, hereinafter mentioned, which invention or improvement was not known or used by others in this country or patented or described in any printed publication in this or any foreign country, prior to his invention thereof, or more than two years prior to his application for said Letters Patent; had not been in public use or on sale in this country for more than two years prior to said application; had not been abandoned to the public, and had not been patented or caused to be patented by him or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to the filing of his application for Letters Patent of the United States therefor; that the said Frank Jardine made due application to the Commissioner of Patents of the United States in accordance with the then existing Acts of Congress, for Letters Patent of the United States for said invention and improvement, and having in all respects complied with the conditions and requirements of said Acts of Congress, and having, by mesne assignments, as will more fully and at large appear upon production in Court of said assignments, assigned his entire right, title and interest in and to said Letters Patent No. 1,763,523 to The Cleveland Trust Company, as Trustee, and having authorized and requested the Commissioner of Patents to issue the Letters Patent upon said application and for said invention and improvements to said The Cleveland Trust Company, on or about the 10th day of June, 1930, Letters Patent of the United States No. 1,763,523, signed, sealed and executed in due form of law, for the said invention or improvement, were issued and delivered to plaintiff, The Cleveland Trust Company, whereby there was secured to it, its successors and assigns, for the term of seventeen years from the said 10th day of June, 1930, the sole and exclusive right to make, use, and sell to others to be used, throughout the United States and the territories thereof, the aforesaid invention or improvement, all as by said Letters Patent or a duly authenticated copy thereof in Court to be produced and shown unto Your Honors, will more fully and at large appear.

15.

That heretofore and prior to the 30th day of November, 1917, Edward J. Gulick, a citizen of the United States then residing in Mishawaka, County of St. Joseph, and State of Indiana, was the original, first and true inventor of certain new and useful improvements in Pistons, fully described in application for Letters Patent of the United States, Serial No. 204,661, which invention was not known or used by others in this country or patented or described in any printed publication in this or any foreign country, prior to his invention thereof, or more than two years prior to his said application for Letters Patent therefor; that said invention had not been in public use or on sale in this country for more than two years prior to said application for Letter Patent, had not been abandoned to the public and had not been patented or caused to be patented by him or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to the filing of said application for Letters Patent of the United States; that on or about November 30, 1917, said Edward J. Gulick made due application to the Commissioner of Patents of the United States in accordance with the then existing Acts of Congress, for Letters Patent of the United States for said invention or improvements and, having in all respects complied with the conditions and requirements of said Acts of Congress, on the 21st day of July, 1931, Letters Patent of the United States No. 1,815,733 were signed, sealed and executed in due form of law for the said invention, and were issued and delivered unto Plaintiff, The Cleveland Trust Company, its successors and assigns, as assignee of the entire right, title and interest of said Edward J. Gulick, for the term of seventeen years from said 21st day of July, 1931, thereby granting to it the sole and exclusive right to make, use and sell to others to be used, throughout the United States, its territories and dependencies, the aforesaid invention or improvements, all as by said Letters Patent or a duly authenticated copy thereof in Court to be produced and shown to Your Honor, as will more fully and at large appear.

16.

That prior to the grant of aforesaid Letters Patent No. 1,815,733, said Edward J. Gulick assigned to the Packard Motor Car Company of Detroit, Michigan, his

entire right, title, and interest in and to the invention set forth and described in the aforesaid application for Letters Patent Serial No. 204,661 by an instrument in writing dated Nov. 23, 1917 that was duly recorded in the United States Patent Office on or about the 30th day of November, 1917, in Liber J-103, page 468 of the Transfers of Patents; whereby said Packard Motor Car Company of Detroit, Michigan, its successors and assigns became vested with the entire right, title and interest in and to the aforesaid invention and in and to said application for Letters Patent Serial No. 204,661 and in and to any Letters Patent issuing pursuant thereto.

17.

That, on or about September 11, 1922 and prior to the grant of aforesaid Letters Patent No. 1,815,733, the Packard Motor Car Company of Detroit, Michigan, assigned to The Cleveland Trust Company of Cleveland, Ohio, its entire right, title and interest in and to the invention set forth and described in the aforesaid application for Letters Patent Serial No. 204,661 and in and to said application for Letters Patent by an instrument in writing dated September 11, 1922 that was duly recorded in the United States Patent Office on or about the 13th day of September, 1922, in Liber S-116, page 465 of the Transfers of Patents, whereby said The Cleveland Trust Company of Cleveland, Ohio, its successors and assigns became vested with, has continuously held and now owns the entire right, title and interest in and to said invention and in and to said application for Letters Patent Serial No. 204,661 and in and to said Letters Patent of the United States No. 1,815,733 that issued pursuant thereto.

18.

That the validity of each of the aforesaid Letters Patent has been recognized and acquiesced in by the public generally since the date of issue of each of said patents, except for these defendants and others encouraged by them. At various times said patents have been especially recognized and acquiesced in by parties who have discontinued infringement thereof and who have made due amends to plaintiff. Others have taken licenses under said patents. Substantial and material royalties have been paid to the plaintiff under said patents. The licensees under said patents have manufactured and sold the pistons covered by said patents in great numbers.

These pistons have gone into extensive and successful use. Licensees under said patents have built plants and established organizations for the manufacture and sale of such pistons on the strength of and by reason of their confidence in the patents here in suit.

19.

That the plaintiff has duly notified each and both of these defendants of their infringement of each of the aforesaid Letters Patent and has requested them and each of them to desist, but defendants and each of them have continued their infringements in defiance of said notices.

20.

These defendants, The Schriber-Schroth Company and Sterling Products Corporation, jointly and severally, subsequent to the grant of said Letters Patent and prior to the filing of this Bill of Complaint and within six years hereof, with full knowledge of each of said Letters Patent and without the consent of plaintiff, The Cleveland Trust Company, but in violation of its rights, and after due notice, has within the Judicial District of this Court and elsewhere within the United States, infringed each of the aforesaid Letters Patent and contributed to the infringement thereof by making and/or causing to be made, by using and/or causing to be used, and selling and/or causing to be sold in this Judicial District and elsewhere within the United States, Pistons for Internal Combustion Engines embodying jointly and severally the inventions of said Letters Patent and in infringement thereof.

That in so infringing, defendants have realized and received great gains and profits which should, and otherwise would have been received by plaintiffs, each and both of them, and defendants, and each and both of them, have correspondingly inflicted on plaintiffs great loss and damage, but to what extent plaintiffs cannot now set forth and therefore pray discovery with respect thereto; that plaintiffs fear and have reason to fear that defendants will continue their aforesaid infringing acts to an even greater extent unless enjoined by this Honorable Court; and defendants, and each of them, have and will thereby induce others to venture to infringe the said Letters Patent aforesaid, to the irreparable injury of plaintiffs.

21.

That suit was heretofore instituted in this Honorable Court by Plaintiffs in this cause against The Simmons Manufacturing Company of Cleveland, Ohio and Sterling Products Corporation of St. Louis, Missouri, Co-Defendants, for the infringement of the foregoing Letters Patent of the United States by the use and sale of pistons of the same construction that is herein charged to infringe and that a consent decree was entered against defendant, The Simmons Manufacturing Company, on September 25, 1931 and that said The Simmons Manufacturing Company was also enjoined from further using or selling said infringing pistons.

22.

Because of these premises, plaintiffs are without adequate or sufficient remedy at law and therefore bring this suit in equity.

WHEREFORE, the plaintiffs pray:

First. That a writ of subpoena ad respondendum may issue out of and under the seal of this Court requiring each and both of said defendants, The Schriber-Schroth Company and Sterling Products Corporation, to appear and make answer to this Bill of Complaint, but not under oath, answer under oath being hereby expressly waived, to the best and utmost of their knowledge, information and belief and to do and perform such things as to this Court may seem meet and just;

Second. That this Court may grant an injunction, perpetual as well as temporary, enjoining each and both of said defendants, The Schriber-Schroth Company and Sterling Products Corporation, as well as each of the directors, officers, associates, successors, agents, attorneys and employees, and every person acting for or on the behalf of each and/or both of said defendants, from further infringing or contributing to the infringement of any and/or each of said Letters Patent.

Third. That said defendants, The Schriber-Schroth Company and Sterling Products Corporation, and each and both of them, may be required to account before a Master in the usual manner of accountings for the gains, profits and advantages due to and arising out of their aforesaid infringements and contributory infringements herein complained about, as well as the damages sus-

tained by plaintiffs, by reason of said infringements, and that the said damages be tripled.

Fourth. That said defendants, The Schriber-Schroth Company and Sterling Products Corporation, each and both of them, be required to pay over to plaintiffs, the gains and profits so accounted for and also the damages sustained by plaintiffs as the result of said infringements and contributory infringements.

Fifth. That the defendants, each and both of them, be decreed to pay the costs, charges and disbursements of this suit.

Sixth. That the plaintiffs may have such other and further relief as the equity of the case may require, and as to this Honorable Court may seem just and proper.

THE CLEVELAND TRUST COMPANY,
By R. A. MALM,
Vice-President.

CHRYSLER CORPORATION,
By R. A. MALM,
Vice-President, The Cleveland Trust Company.

WM. C. McCoy,
Solicitor for Plaintiffs.

AFFIDAVIT.

STATE OF OHIO,
COUNTY OF CUYAHOGA, ss.:

On this 15th day of October, 1931, before the undersigned, a Notary Public within and for the County and State aforesaid, personally appeared R. A. Malm and made oath that he is the Vice President of The Cleveland Trust Company, the above named complainant, that he has read the foregoing Bill of Complaint, and knows the contents thereof, and that the same is true, except as to those matters stated on information and belief, and as to those matters he believes it to be true.

(Notarial Seal) JOHN T. MOORE,
Notary Public.

MOTION OF DEFENDANT, THE SCHRIBER-SCHROTH COMPANY FOR FURTHER AND BETTER STATEMENT AND FURTHER PARTICULARS.

(Filed November 9, 1931.)

[Case No. 4045.]

Now comes The Schriber-Schroth Company, defendant in the above-entitled cause, and moves that Plaintiff The Cleveland Trust Company be ordered, under the provisions of Equity Rule 20, to furnish a further and better statement of the nature of plaintiffs' claim and further and better particulars of the matters stated in the Bill of Complaint in the following respects:

I. With reference to each and all of the patents in suit, state:

A. Does The Cleveland Trust Company hold both the legal title and the beneficial interest or equitable title to said patents?

B. Does The Cleveland Trust Company hold title as trustee?

C. List the holders of beneficial interests, and the proportions or percentages or shares of such beneficial interests.

D. Is Bohn Aluminum & Brass Corporation, mentioned in paragraph 8 of the Bill, a holder of a beneficial interest?

E. Is Aluminum Company of America, mentioned in paragraph 11 of the Bill, a holder of a beneficial interest?

F. Is Packard Motor Car Company, mentioned in paragraph 16 of the Bill, a holder of a beneficial interest?

G. Furnish a copy, or copies, of all agreements or declarations of trust, and amendments or additions thereto, by virtue of which The Cleveland Trust Company may hold title for beneficiaries or cestuis que trustant.

II. With reference to paragraph 14 of the Bill, list the assignments referred to as "meane assignments."

III. With reference to paragraph 18 of the Bill, name the licensees who are holders of beneficial interests under any agreement or declaration of trust by virtue of which The Cleveland Trust Company holds title to any or all of the patents in suit.

C

IV. With reference to paragraph 20 of the Bill:

A. Furnish a sample, specimen, drawing, or illustration of the piston which will be relied upon at the trial as having been sold by Defendant The Schriber-Schroth Company; and if there is more than one piston, furnish a sample, specimen, drawing, or illustration of each of the pistons which will be relied upon at the trial.

B. Specify the claims in each patent which will be relied upon at the trial as infringed by Defendant, The Schriber-Schroth Company; and as to these, particularize by patent number and claim with reference to each piston, if more than one.

C. Does The Cleveland Trust Company manufacture or sell any pistons coming within the scope of any or all of the patents in suit and as to which loss and damage are alleged?

And Defendant further moves that an Order be entered that Plaintiff The Cleveland Trust Company file such particulars and serve upon Defendant The Schriber-Schroth Company a copy of the same, together with copies of all exhibits, within fifteen (15) days after the entry of said Order. And defendant further moves that such Order as to costs be made herein as may be just.

THE SCHRIBER-SCHROTH COMPANY,

By KWIK, HUDSON & KENT,

Solicitors.

Cleveland, Ohio,
November 5, 1931.

Service of a copy of the foregoing Motion is acknowledged this 9th day of November, 1931.

WM. C. McCox,

Solicitors for Plaintiffs.

ORDER ON MOTION OF DEFENDANT THE SCHRIBER-SCHROTH COMPANY FOR FURTHER AND BETTER STATEMENT AND FURTHER PARTICULARS, OVERRULING ALL BUT PARAGRAPH IV B.

(Entered December 30, 1931 by Paul Jones, Judge.)

This day this cause came on to be heard on the motion of defendant The Schriber-Schroth Company for further and better statement and further particulars, and was submitted to the Court; on consideration thereof the Court overruled said motion as to all paragraphs except IV B, and granted said motion as to paragraph IV B.

PLAINTIFF'S BILL OF PARTICULARS.

(Filed January 8, 1932.)

[Case No. 4045.]

Now come the Plaintiffs and, for their Bill of Particulars in response to Section IV B of the motion of Defendant, The Schriber-Schroth Company, and in accordance with the Court Order of December 30, 1931 regarding the aforesaid motion, state as follows:

At the trial of this cause Plaintiffs intend to rely on the following claims of the patents listed as infringed and/or as contributorily infringed by Defendant:

Mooers Patent, No. 1,402,309, Claims 1, 2, 6, 9 and 10.

Schmiedeknecht Patent, No. 1,256,265, Claims 1 and 3.

Maynard Patent, No. 1,655,968, All of the claims.

Jardine Patent, No. 1,763,523, All claims except 3 and 12.

Gulick Patent, No. 1,815,733, Claims 1, 11, 12, 13, 15, 18, 30, 33, 35, 38, 41, 42 and 43.

Plaintiffs intend to rely on pistons like Plaintiffs' Exhibit 1 (submitted herewith) and pistons of the same kind in which the longitudinal slot in the piston skirt is completed for installation in an engine by cutting the longitudinal slot through at the top and bottom of the skirt, as indicated in pencil on the accompanying piston, Plaintiffs' Exhibit 1, as the infringing pistons.

Respectfully submitted,

Wm. C. McCoy,

Attorney for Plaintiffs.

Service and receipt of copy of foregoing Bill of Particulars acknowledged this . . . day of January, 1932.

KWIE, HUDSON & KENT,

*Attorneys for Defendant, The
Schriber-Schroth Company.*

PETITION OF JOHN H. BRUNINGA TO ENTER HIS SPECIAL APPEARANCE, IN ORDER TO ENTER A SPECIAL APPEARANCE ON BEHALF OF STERLING PRODUCTS CORPORATION, FOR THE SOLE AND ONLY PURPOSE OF OBJECTING TO THE JURISDICTION.

(Filed November 9, 1931.)

[Case No. 4045.]

Now comes John H. Bruninga and states:

That he is attorney at law, admitted to practice before the Supreme Court of the United States and the District Court of the United States for the Eastern District of Missouri, and that he resides in the City of St. Louis, State of Missouri.

That Sterling Products Corporation is a corporation duly organized and existing under the laws of the State of Missouri and has its principal and only place of business in the City of St. Louis, State of Missouri; and that said Sterling Products Corporation has no office nor place of business, nor any regular and established place of business, nor any agent within the Northern District of Ohio or within the jurisdiction of this Court. That said Sterling Products Corporation has not been served with process in the above-entitled cause and has not entered its appearance in that cause.

That a few days after May 17, 1930, said Sterling Products Corporation received from Evans & McCoy, solicitors for plaintiffs in the above-entitled cause, a letter dated May 17, 1930, photostat of which is attached hereto, and the original of which will be produced in Court, but that to date no suit has been brought against Sterling Products Corporation at the only place where it can be served—namely, St. Louis, Missouri.

That on September 29, 1930, suit was instituted in this Court by plaintiffs against The Simmons Manufacturing Company, naming said Sterling Products Corporation as a defendant, said suit being entitled Equity No. 3510; but that said Sterling Products Corporation was not served with process nor did it enter its appearance in that cause.

That on November 24, 1930, John H. Bruninga, patent counsel for said Sterling Products Corporation, sent a letter, photostat of a carbon copy of which is attached hereto, and the original of which is in the possession of Evans & McCoy, solicitors for plaintiffs in the above-

entitled cause, as the same was acknowledged; but that to date no suit has been brought against Sterling Products Corporation, at the only place where it can be legally served—namely, St. Louis, Missouri.

That on September 25, 1931, a consent decree, entitled "Interlocutory Decree," was entered in said suit Equity No. 3510, but said decree was consented to only by The Simmons Manufacturing Company, the defendant in that cause, and that Sterling Products Corporation was not a party to said decree and did not consent to said decree.

That on October 1, 1931, plaintiffs filed a motion in said cause, Equity No. 3510, entitled "Motion for an Order to Proceed before the Master to Take Testimony to Show That the Decree Entered September 25, 1931, against the defendant The Simmons Manufacturing Company Should Be Extended to Apply to Sterling Products Corporation, and for a Report of the Master on This Subject," and that said motion stated that "Sterling Products Corporation therefore conducted the defense of the suit to the exclusion of The Simmons Manufacturing Company and paid for the defense of the suit to their exclusion."

* That on October 9, 1931, said Evans & McCoy sent a letter to Chicago Auto Parts, Inc., of Chicago, Illinois, one of the customers of said Sterling Products Corporation, which letter stated, "We are advised that Sterling Products Corporation refused to furnish a bond to The Simmons Manufacturing Company and to contest the suit on the merits in behalf of The Simmons Manufacturing Company." A photostat of said letter is attached hereto, and the original will be produced in Court.

That on October 10, 1931, said Evans & McCoy sent a letter to Automotive-Supply Co., Inc., of Appleton, Wisconsin, one of the customers of said Sterling Products Corporation, which again stated, "We are advised that Sterling Products Corporation refused to furnish a bond to the Simmons Manufacturing Company and to contest the suit on the merits in behalf of The Simmons Manufacturing Company"; and further stated that "Sterling Products Corporation was also made a party defendant in this suit." A photostat of said letter is attached hereto, and the original will be produced in Court.

That, in addition to the above-entitled suit, the plaintiffs have recently filed two other suits against the following parties;

The Aberdeen Motor Supply Company, Equity
No. 4046

The F. E. Rowe Sales Company, Equity No.
4047

again naming Sterling Products Corporation; but that said Sterling Products Corporation has not been served with process, nor has it entered its appearance in either of said causes.

That by naming Sterling Products Corporation in the above-entitled cause, Sterling Products Corporation is liable to be prejudiced, particularly since, as in said Equity Cause No. 3510, filed by plaintiffs against The Simmons Manufacturing Company, the Sterling Products Corporation's relation is not only liable to be misconstrued, but such naming taken advantage of by incorrect statements of fact and law, as in said letters aforesaid.

Now, therefore, I, the said John H. Bruninga, pray leave to appear before this Court, to enter my special appearance in this cause, in order to enter a special appearance on behalf of said Sterling Products Corporation, for the sole and only purpose of objecting to the jurisdiction of this Court and for the purpose of praying this Court:

First, to dismiss the above-entitled cause as to Sterling Products Corporation, because this Court is without jurisdiction or power over Sterling Products Corporation.

Second, to expunge the name of Sterling Products Corporation from the Bill of Complaint in the above-entitled cause.

The undersigned, therefore, prays for an oral hearing before this Court and that this Court direct such an oral hearing and grant leave for said Sterling Products Corporation to appear specially, but not generally, as aforesaid.

Respectfully submitted,

JOHN H. BRUNINGA,

*Appearing specially, but not generally,
as aforesaid, on behalf of Sterling
Products Corporation.*

St. Louis, Missouri,
November 5, 1931.

Service of the above acknowledged, and copy accepted this 9th day of November, 1931.

Wm. C. McCoy,
Solicitor for Plaintiffs.

EVANS & McCOY
PATENT LAWYERS
Bulkley Building
Cleveland

May 17, 1930.

Sterling Products Corporation,
2916 North Market Street,
St. Louis, Mo.

Gentlemen:

You are advised that pistons that you are now offering to the trade infringe the following patents that are owned by The Cleveland Trust Company of Cleveland, Ohio:

		Issued
Mooers-Spillman	Pat. No. 1,092,870	4/14/14
Franquist	" No. 1,153,902	9/21/15
Howdeshell	" No. Re-16,273	2/23/26
(Original)	" No. 1,473,233	9/ 6/23
Mooers	" No. 1,402,309	1/ 3/22
Maynard	" No. 1,655,968	1/10/28

It is our understanding that you have heretofore considered these patents in connection with your business activities and therefore are familiar with them.

The Cleveland Trust Company has authorized us to say on their behalf that, unless you cease infringement and account for past damages and profits, suit will be brought forthwith.

Yours very truly,

EVANS & McCOY.

WCM/LR

November 24, 1930.

Evans & McCoy,
Bulkley Building,
Cleveland, Ohio.

Gentlemen:

I have been informed by my client, Sterling Products Corporation, that you have been writing my client's customers in various parts of the United States, not only calling their attention to the fact that pistons purchased by them from Sterling Products Corporation and offered by those customers to the trade, infringe the various patents of the Cleveland Trust Company, for which you brought suit against The Simmons Manufacturing Company, of which you sent me a copy of the bill of complaint, but also threatening those customers that unless they cease offering those Sterling pistons for sale and even account for damages and profits, suit will be brought forthwith against those customers. My client has given me the originals of a number of these letters, and they are all to the above effect.

Now, I do not want to advise you as to the legal situation created by the above proceeding, nor tell you what liabilities your client is incurring; for you, no doubt, have made up your own mind as to that. I, however, will say that in my opinion this action in behalf of your client constitutes unfair competition in trade, for which my client will hold your client strictly accountable. In my opinion, this matter has gone way beyond what is permitted by the well considered decisions of the courts in the various Circuits; for your client has not instituted suit directly against Sterling Products Corporation, and is apparently afraid to do so. It is true you attempted to join my client in the Cleveland suit with The Simmons Manufacturing Company; however, that Court has no jurisdiction of Sterling Products Corporation, and my client was never served, and the Marshal's return shows that Sterling Products Corporation was not, and could not be, served in the Cleveland District.

My client stands ready to defend any suit which you may want to institute against Sterling Products Corporation in the United States District Court for the Eastern Division of the Eastern Judicial District of Missouri, sitting at St. Louis, Missouri. My client will not, however, tolerate this continual intimidation of customers, and even suits brought against customers. I, therefore,

would like to know as speedily as possible what the intentions of you and your client are with reference to this situation. Do you intend to simply intimidate customers and bring suits against customers, or do you intend to sue my client where you can get service on my client? Please let me hear from you by not later than November 28, 1930.

Very truly yours,

J. H. BRUNINGA.

JHB:HB

EVANS & McCOY
PATENT LAWYERS
Bulkley Building
Cleveland

October 9, 1931.

Chicago Auto Parts,
3053 Lawrence Ave.,
Chicago, Ill.

Gentlemen:

Sometime ago we wrote you a letter advising you that, in our opinion, the split skirt pistons which you were buying from Sterling Products Corporation and selling were, or would be when completed, an infringement of each of the following patents, and advising you that we would institute suits against you if you did not discontinue such infringement:

Spillman & Mooers	1,092,870
Mooers	1,402,309
Franquist	1,153,902
Schmiedeknecht	1,256,285
Howdeshell	Re-16,273
Maynard	1,655,968
Jardine	1,763,523
Gulick	1,815,733

We think we ought at this time to advise you that we instituted suit under these patents against The Simmons Manufacturing Company here in Cleveland last October for the sale of such pistons. Sterling Products Corporation was also named as a defendant. On September 25, 1931, The Simmons Manufacturing Company consented to the entry of a decree holding the said patents valid and infringed, and such decree was entered on

that date. An injunction has accordingly been issued against The Simmons Manufacturing Company enjoining that company from further selling such pistons and further infringing any of these patents during the life thereof, and ordering them to account to the owners of the patents for profits made by them on the pistons, damages incurred by the owners as a result of the infringement, and costs of the suit. We would be very glad to send you a copy of this decree and of this injunction if you are interested enough in it to wish copies.

We were advised that Sterling Products Corporation refused to furnish a bond to The Simmons Manufacturing Company and to contest the suit on the merits in behalf of The Simmons Manufacturing Company. If you wish affirmance of our advice or further particulars, you may think it wise to communicate with The Simmons Manufacturing Company, 3405 Perkins Avenue, Cleveland, Ohio.

We are writing you this information in the hope that you will not infringe these patents so that litigation may be avoided or limited.

Very truly yours,

EVANS & McCOY.

WCM/LR

EVANS & McCOY
PATENT LAWYERS
Bulkley Building
Cleveland

October 10, 1931.

Automotive Supply Co.-Inc.,
128 N. Appleton St.,
Appleton, Wisc.

Gentlemen:

Your frank letter of September 16, 1931 is appreciated.

In accordance with your request we advise you that suit was instituted against The Simmons Manufacturing Company in Cleveland in September, 1930, for the sale of pistons supplied to them by Sterling Products Corporation, and Sterling Products Corporation was also made a party defendant in this suit. This suit was first set for hearing in June, 1931 and this setting was then changed to September 28, 1931.

On September 25, 1931, The Simmons Manufacturing Company consented to the entry of a decree holding the said patents valid and infringed, and such decree was entered against The Simmons Manufacturing Company, enjoining that Company from further selling such pistons or further infringing any of these patents during the life thereof, and ordering them to account to the owners of the patents for profits made by them on the pistons, damages incurred by us as a result of the infringement and costs of the suit. We would be very glad to send you a copy of this decree and of this injunction if you are interested enough in it to wish copies.

We were advised that Sterling Products Corporation refused to furnish a bond to The Simmons Manufacturing Company and to contest the suit on the merits in behalf of The Simmons Manufacturing Company. If you wish affirmance of our advice or further particulars, you may think it wise to communicate with The Simmons Manufacturing Company, 3405 Perkins Avenue, Cleveland, Ohio.

We are writing you this information in the hope that you will not infringe these patents so that litigation may be avoided or limited.

Yours very truly,

EVANS & McCoy.

WCM: W

ORDER GRANTING PETITION OF JOHN H. BRUNINGA FOR LEAVE TO ENTER SPECIAL APPEARANCE OF STERLING PRODUCTS CORPORATION—TO OBJECT TO JURISDICTION.

(Entered December 30, 1931 by Paul Jones, Judge.)

[Case No. 4045.]

This day this cause came on to be heard on the petition of John H. Bruninga for leave to enter his special appearance, in order to enter a special appearance on behalf of Sterling Products Corporation, for the sole and only purpose of objecting to the jurisdiction, and was submitted to the Court; on consideration thereof the Court granted leave.

ANSWER OF DEFENDANT, THE SCHRIBER-SCHROTH COMPANY, TO BILL OF COMPLAINT.

(Filed February 1, 1932.)

[Case No. 4045.]

Now comes defendant, The Schriber-Schroth Company, and for its Answer to the Bill of Complaint says:

1.

Answering Paragraph 1 of the Bill, defendant admits the existence, organization and place of business of The Cleveland Trust Company, but denies the status of Chrysler Corporation as alleged.

2.

Answering Paragraph 2 of the Bill, defendant admits its incorporation and place of business as alleged, but having no knowledge as to the organization and place of business of Sterling Products Corporation, denies the allegations with respect thereto.

3.

Answering Paragraph 3 of the Bill, defendant denies the jurisdiction of this Court as to the subject matter alleged and relief prayed.

4.

Answering Paragraph 4 of the Bill, defendant admits that on June 2, 1917 one Louis P. Mooers filed an application, Serial No. 172,380, but denies that said application disclosed the subject matter of patent No. 1,402,309, and further denies that the Statutory prerequisites had been complied with as alleged.

5.

Answering Paragraph 5 of the Bill, defendant has no knowledge save said allegations as to the various alleged assignments, and therefore, denies the same, and further denies that The Cleveland Trust Company became vested with and holds the entire right, title and interest in and to said patent No. 1,402,309.

6.

Answering Paragraph 6 of the Bill, defendant admits that on July 14, 1917 one Victor E. Schmiedeknecht

filed an application, Serial No. 180,511, and that on February 12, 1918 patent No. 1,256,265 issued to said Schmiedeknecht, but denies that said application disclosed the subject matter of patent No. 1,256,265, and further denies that the Statutory prerequisites had been complied with as alleged.

7.

Answering Paragraph 7 of the Bill, defendant has no knowledge save the allegations as to the assignment and guarantee to Frank Kent as alleged, and therefore, denies the same.

8.

Answering Paragraph 8 of the Bill, defendant has no knowledge save the allegations as to the alleged assignment by Frank Kent to Bohn Aluminum & Brass Corporation as alleged, and, therefore, denies the same.

9.

Answering Paragraph 9 of the Bill, defendant has no knowledge save the allegations as to the assignment by Bohn Aluminum & Brass Corporation to The Cleveland Trust Company as alleged, and, therefore, denies the same; and defendant denies that The Cleveland Trust Company became vested with and now holds the entire right, title and interest in and to said patent No. 1,256,265.

10.

Answering Paragraph 10 of the Bill, defendant admits that on January 3, 1921 one Howard E. Maynard filed an application, Serial No. 434,467, but denies that said application disclosed the subject matter of patent No. 1,655,968; and further denies that the Statutory prerequisites had been complied with as alleged.

11.

Answering Paragraph 11 of the Bill, defendant admits the issue of patent No. 1,655,968 on January 10, 1928, jointly to Chrysler Corporation and Aluminum Company of America, but denies proper issuance of said patent to said alleged patentees, and denies that there was thereby secured to said Chrysler Corporation and Aluminum Company of America the sole and exclusive right to make, use and sell to others to be used through-

out the United States and the territories thereof, any alleged invention or improvement described in said patent.

12.

Answering Paragraph 12 of the Bill, defendant has no knowledge save the allegations as to the assignment by Aluminum Company of America to The Cleveland Trust Company as alleged, and, therefore, denies the same; and further denies sufficient title by The Cleveland Trust Company of said patent to warrant institution of suit for infringement thereof by The Cleveland Trust Company.

13.

Answering Paragraph 13 of the Bill, defendant has no knowledge save the allegations as to whether Chrysler Corporation is a non-resident, residing without the jurisdiction of this Court and cannot be made a co-defendant; as to whether The Cleveland Trust Company has advised Chrysler Corporation of the imminent pendency of this case and of the obligation of Chrysler Corporation to join voluntarily in the bringing of this suit; as to whether Chrysler Corporation has refused or declined to voluntarily join as alleged; defendant, therefore, denies such allegations. Defendant further denies that The Cleveland Trust Company is without remedy on the Maynard patent unless Chrysler Corporation is joined as a co-plaintiff in this cause, and further denies that Chrysler Corporation is made a plaintiff in this cause instituted in this District without its consent in order to prevent a failure of justice and to enable The Cleveland Trust Company to protect its interest herein.

14.

Answering Paragraph 14 of the Bill, defendant admits that on March 11, 1920 one Frank Jardine filed an application, Serial No. 364,997, but denies that said application disclosed the subject matter of patent No. 1,763,523, and further denies that the Statutory prerequisites had been complied with as alleged. Defendant admits issue of patent No. 1,763,523 on June 10, 1930 to The Cleveland Trust Company as Trustee, but defendant has no knowledge as to the mesne assignments alleged, and therefore, denies the same; defendant further denies that The Cleveland Trust Company has the sole and exclusive right to make, use and sell to others to be used throughout the United States and the territories

thereof, any alleged invention or improvement disclosed in said patent.

15.

Answering Paragraph 15 of the Bill, defendant admits that on November 30, 1917 one Edward J. Gulick filed an application, Serial No. 204,661, but denies that said application disclosed the subject matter of patent No. 1,815,733, and further denies that the Statutory prerequisites had been complied with as alleged. Defendant admits that patent No. 1,815,733 issued on June 21, 1931 to The Cleveland Trust Company, but denies that thereby there was granted to said The Cleveland Trust Company the sole and exclusive right to make, use and sell to others to be used throughout the United States, its territories and dependencies, any alleged invention or improvement disclosed in said patent.

16.

Answering Paragraph 16 of the Bill, defendant has no knowledge save the allegations as to any alleged assignment by said Gulick to Packard Motor Car Company, and, therefore, denies the same.

17.

Answering Paragraph 17 of the Bill, defendant has no knowledge save the allegations as to any alleged assignments by Packard Motor Car Company to The Cleveland Trust Company, and; therefore, denies the same.

18.

Answering Paragraph 18 of the Bill, defendant denies recognition and acquiescence in and by the public of the validity of any or all of the aforesaid patents; denies special recognition and acquiescence in and by parties who have discontinued infringement thereof and who have made amends to plaintiff; denies licenses, payment of material royalties, manufacture and sale of pistons under any or all of said patents by licensees, and extensive and successful use of such pistons. Defendant denies that any licensees under said patents have built plants and established organizations for the manufacture and sale of such pistons on the strength of and by reason of their confidence in the patents in suit; but on the contrary, defendant states that as alleged The Cleveland

Trust Company is a mere title holder, holding the patents in suit for the benefit of a limited number of piston manufacturers as *cestuis qui trustent* or beneficiaries under agreements and declarations of trust including Aluminum Company of America, Bohn Aluminum & Brass Corporation, United States Aluminum Company and Aluminum Industries Corporation; that such *cestuis qui trustent* or beneficiaries are in turn licensees under the patents in suit; and that the entire arrangement is one to restrain competition in trade, to fix prices and to create a monopoly in the manufacture and sale of pistons.

, 19.

Answering Paragraph 19 of the Bill, defendant admits notification by plaintiff, The Cleveland Trust Company, of the patents in suit and of said The Cleveland Trust Company's contention that a certain piston, like Plaintiffs' Exhibit 1 submitted with plaintiffs' Bill of Particulars, infringe said patents in suit, but defendant denies that it has infringed or continued to infringe any or all of said patents.

20.

Answering Paragraph 20 of the Bill, defendant admits that since the issue of all of said patents, and prior to the filing of the Bill herein defendant has sold in this District pistons like Plaintiffs' Exhibit 1, submitted with plaintiffs' Bill of Particulars, and further admits that the slot in the skirt of said piston is intended to be completed to the top and bottom of the skirt prior to installation in an engine. Defendant further admits that it has purchased such pistons from Sterling Products Corporation, a Missouri corporation, having its place of business at St. Louis, Missouri, and beyond the jurisdiction of this Court, by orders placed and filled in St. Louis, Missouri, and shipped from St. Louis, Missouri, by said Sterling Products Corporation. Defendant denies that defendant and Sterling Products Corporation have jointly and severally infringed any or all of the patents in suit or contributed to the infringement thereof by making and/or causing to be made, or by using and/or causing to be used, or by selling and/or causing to be sold in this District or elsewhere, Pistons for Internal Combustion Engines embodying jointly and severally any or all of the inventions of the patents in suit. Defendant further denies that it has realized or received any gains and

profits or has inflicted on plaintiff any damage on account of any sale or marketing of pistons, and defendant further denies that it intends to infringe any of the patents in suit or to induce others to venture to infringe. Defendant states that The Cleveland Trust Company, as alleged, is a mere title holder, does not manufacture or market pistons, and that the sale and marketing of pistons by defendant has not inflicted on The Cleveland Trust Company any loss or damage.

21.

Answering Paragraph 21 of the Bill, defendant is not informed, save by the allegations as to the institution of a suit against The Simmons Manufacturing Company and Sterling Products Corporation, as to the entry of a consent decree against The Simmons Manufacturing Company, and as to an injunction against The Simmons Manufacturing Company, and, therefore, denies the same.

22.

Answering Paragraph 22 of the Bill, defendant denies that plaintiffs, and particularly The Cleveland Trust Company are without adequate or sufficient remedy at law and that The Cleveland Trust Company was warranted to institute this suit and is entitled to maintain the same in a Court of Equity but alleges that this suit has been instituted in order to harass defendant because defendant is a customer of Sterling Products Corporation, a Missouri corporation, which corporation is a non-resident and beyond the jurisdiction of this Court. That this suit is one of a series of suits which have been instituted in this District against customers of said Sterling Products Corporation, said other suits being respectively, Equity Nos. 4046 and 4047, in each of which suits Sterling Products Corporation has been named as a party defendant with said customer, and in each of which suits the piston relied upon as being an infringement is the same piston as relied upon herein; that defendant is informed, and, therefore, avers that Sterling Products Corporation has invited plaintiff, The Cleveland Trust Company, to institute a suit for infringement of the patents in suit at St. Louis, Missouri, the place of residence of said Sterling Products Corporation, but that plaintiff, The Cleveland Trust Company, has neglected to do so; and that said Sterling Products Corporation is

financially able to respond in profits and damages in case said patents be sustained and infringement thereof found.

23.

Further answering Paragraph 13 of the Bill, defendant alleges that as to the Maynard patent 1,655,968, this suit can not be maintained by The Cleveland Trust Company because Chrysler Corporation is a necessary and even indispensable party because, as alleged, said Chrysler Corporation is a joint owner of an undivided one-half interest in the entire right, title and interest in and to said patent; that said Chrysler Corporation does not appear as a party plaintiff, nor as a party defendant and cannot be made a party plaintiff as alleged because it is beyond the jurisdiction of this Court; and that this suit should, therefore, be dismissed as to the Maynard patent No. 1,655,968.

24.

Further answering, defendant alleges that the causes of action joined in the Bill of Complaint as to the several patents are not joint, because as alleged, the titles of the Mooers patent No. 1,402,309, the Schmiedeknecht patent No. 1,256,265, and of the Gulick patent No. 1,815,733 are in The Cleveland Trust Company; the title of the Jardine patent No. 1,763,523 is in The Cleveland Trust Company as Trustee; and the title of the Maynard patent No. 1,655,968 is jointly in Chrysler Corporation and The Cleveland Trust Company; and that the Bill of Complaint should, therefore, be dismissed as to the Jardine and Maynard patents.

25.

Further answering, defendant avers that the subject matter of each of the Letters Patent in suit, especially when expanded to include the pistons used and sold by defendant, does not constitute patentable subject matter under the law, and that each of said Letters Patent is void for want of invention.

26.

Further answering, defendant avers that the subject matter of each of the Letters Patent in suit, and every substantial and material part thereof, did not exhibit or

embody any substantial variation or change from what belonged to the state of the art as it existed at the time of the alleged inventions or discoveries by the respective applicants, and did not involve the exercise of the inventive faculty or constitute the subject matter of invention proper to be secured by the grant of Letters Patent within the meaning and intent of the Statutes of the United States relating to the grant of patents for inventions and that said patents are accordingly void.

27.

Further answering, defendant avers that said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick, surreptitiously or unjustly obtained Letters Patent for things which were in fact the inventions of others who were using reasonable diligence in adapting and perfecting the same, and that each of said Letters Patent is accordingly void.

28.

Further answering, defendant avers that for the purpose of deceiving the public, the description and specification filed by said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick, were made to contain less than the whole truth relative to their alleged inventions or discoveries, or more than was necessary to produce the desired effect, and that each of said Letters Patent is accordingly void.

29.

Further answering, defendant avers that the description of the alleged invention in the specification of each of said Letters Patent in suit is not in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains or with which it is most closely connected to make, construct, use or employ the same, and that each of said Letters Patent is accordingly void.

30.

Further answering, defendant avers that each of said Letters Patent in suit does not comply with Section 4888 of the Revised Statutes of the United States, in that it does not particularly point out and distinctly claim the part, improvement or combination which the patentee

claims as his invention or discovery, and that each of said Letters Patent is accordingly void.

31.

Further answering, defendant avers that the claims in said Letters Patent in suit, and each of them, are directed to functions and results and do not claim subject matter of invention proper to be secured by the grant of Letters Patent within the meaning and intent of the Statutes of the United States relating to the grant of patents, and that each of said Letters Patent is accordingly void.

32.

Further answering, defendant avers that the patentees Mooers, Schmiedeknecht, Maynard, Jardine and Gulick, claimed in said Letters Patent in suit to be the original and first inventors or discoverers of material or substantial parts of the things patented, of which they were not the original and first inventors or discoverers; that no disclaimers have been entered to such material or substantial parts, and that plaintiff should, therefore, not be allowed to maintain its suit for infringement of any of said Letters Patent against this defendant.

33.

Further answering, defendant avers that during the prosecution of each of the applications of each of the patents in suit, the claims thereof were limited and restricted in the light of the prior art cited by the Examiner and on account of rejections by the Examiner; that the claims must be limited and restricted in the light of the prior art, and that defendant does not infringe any of said Letters Patent or any claims of any of said Letters Patent when so limited and restricted.

34.

Further answering, defendant avers that the patents in suit, and each of them, were and are wholly invalid and void because the alleged inventions, improvements or discoveries purported to be patented thereby and every substantial and material part of each patent was published, described or patented prior to the alleged invention or discovery thereof, by the respective applicants, or more than two years prior to their applications for said patent, in and by the following Letters Patent, the applications therefor, and the following publications:

AS TO THE MOOERS PATENT¹ 1,402,309.

<i>Name</i>	<i>Number</i>	<i>Date</i>
<i>United States</i>		
Spillman & Mooers	1,092,870	April 14, 1914
Riedler	1,259,292	March 12, 1918
Vincent	1,279,184	Sept. 17, 1918
Marmon	1,293,846	Feb. 11, 1919
Franquist	1,153,902	Sept. 21, 1915
Spillman	1,229,540	June 12, 1917
Allyne	1,329,820	Feb. 3, 1920
Church	1,327,147	Jany. 6, 1920
Bamberg	1,329,821	Feb. 3, 1920

French

Chenard & Walcker 468,595 Apr. 28, 1914

AS TO SCHMIEDEKNECHT PATENT 1,256,265.

<i>Name</i>	<i>Number</i>	<i>Date</i>
<i>United States</i>		
Spillman & Mooers	1,092,870	April 14, 1914
<i>British</i>		
Ferry	12,772	May 25, 1914
Pugh	17,256	July 27, 1907
Ricardo	17,953	Dec. 23, 1915

AS TO THE MAYNARD PATENT 1,655,968.

<i>Name</i>	<i>Number</i>	<i>Date</i>
<i>United States</i>		
Spillman & Mooers	1,092,870	April 14, 1914
Long	1,395,441	Nov. 21, 1921
Schmiedeknecht	1,256,265	Feb. 12, 1918
Ebbs	700,309	May 20, 1902
Ricardo	1,294,833	Feb. 18, 1919

French

Chenard-Walcker 468,595 April 28, 1914

British

Ricardo 17,953 Dec. 23, 1915

AS TO THE JARDINE PATENT 1,763,523.

Name	Number	Date
<i>United States</i>		
Ricardo	1,294,833	Feb. 18, 1919
Franquist	1,153,902	Sept. 21, 1915
Ebbs	700,309	May 20, 1902
Long	1,395,441	Nov. 21, 1921
Mooers	1,403,309	Jan. 3, 1922
Anderson	1,283,021	Aug. 29, 1918
Barthel	1,139,396	May 11, 1915

French

Chenard-Walcker	468,595	April 28, 1914
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AS TO THE GULICK PATENT 1,815,733.

Name	Number	Date
<i>United States</i>		
Spillman & Mooers	1,092,870	April 14, 1914
Ebbs	700,309	May 20, 1902
Franquist	1,153,902	Sept. 21, 1915
Vincent	1,279,184	Sept. 17, 1917
Van Bever	1,031,212	July 2, 1912
Knight	1,061,756	May 13, 1913
Allyne	1,329,820	Feb. 3, 1920
Bamberg	1,329,821	Feb. 3, 1920

British

Rainforth	6,826	Mar. 19, 1912
Pugh	17,256	July 27, 1907
Ferry	12,772	May 25, 1914

French

Chenard-Walcker	468,595	April 28, 1914
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and in and by certain other Letters Patent, not now known to defendant, but which when ascertained, defendant prays may be made part of this Answer by amendment thereto.

Answering further, defendant avers that said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick pat-

ents, and each of them, were and are wholly invalid and void, because more than two years prior to the effective filing dates of the applications for the respective patents, the alleged inventions, improvements and discoveries purported to be patented in each of them, or any substantial or material part thereof, were publicly used or on sale in this country by the following persons and corporations at and residing at the following places:

George Dorris
Dorris Motor Car Co.
Elmer Long

St. Louis, Missouri
St. Louis, Missouri
Detroit, Michigan

and
Quincy, Illinois
and

Packard Motor Car Company
Edward J. Gulick

Hannibal, Missouri
Detroit, Michigan
Elkhart, Indiana
and

H. H. Franklin Mfg. Company
Aluminum Castings Company

Detroit, Michigan
Syracuse, N. Y.
Cleveland, Ohio

and by certain other parties not now known to the defendant, but whose names when ascertained, defendant prays may be made part of this Answer by amendment thereto.

36.

Further answering, defendant avers that said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick patents and each of them, were and are wholly invalid and void, because said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick were not the original and first inventors or discoverers of the alleged inventions, improvements or discoveries purported to be patented therein, or any substantial or material part thereof, but that the same, and every substantial and material part thereof were, prior to the alleged inventions thereof by said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick developed or known and used by others in this country at and residing at the following places:

George Dorris
Elmer Long

St. Louis, Missouri
Detroit, Michigan
and
Quincy, Illinois
and

E. O. Spillman
Carl R. Green
Jesse G. Vincent
Howard G. Marmon
Charles Y. Knight
Charles C. Anderson
Gustave E. Franquist
Edmund E. Allyne
Joseph H. Bamberg

Hannibal, Missouri
No. Tonawanda, N. Y.
Dayton, Ohio
Detroit, Michigan
Indianapolis, Indiana
Chicago, Illinois
Cedar Rapids, Iowa
New Brunswick, N. J.
Cleveland, Ohio
Tonawanda, N. Y.

and by certain other persons and corporations not now known to defendant, but whose names, when ascertained, defendant prays may be made part of this Answer by amendment thereto.

37

Further answering, defendant avers that said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick patents, and each of them were and are wholly invalid and void, because said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick, were not the original and first inventors or discoverers of the alleged inventions, improvements, or discoveries purported to be patented therein, or any substantial or material part thereof, but that the same and every substantial and material part of each patent, was prior to said alleged invention thereof by said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick conceived by others in this country, who were using reasonable diligence in adapting and perfecting the same, to-wit, by the following persons residing at the following places:

George Dorris
Elmer Long

St. Louis, Missouri
Detroit, Michigan
and
Quincy, Illinois
and

E. O. Spillman
Carl R. Green
Jesse G. Vincent

Hannibal, Missouri
North Tonawanda, N. Y.
Dayton, Ohio
Detroit, Michigan

Howard G. Marmon
Charles Y. Knight
Charles C. Anderson
Gustave E. Franquist
Harold D. Church

Indianapolis, Indiana
Chicago, Illinois
Cedar Rapids, Iowa
New Brunswick, N. J.
Detroit, Michigan

and by certain other persons and corporations not now known to defendant, but whose names, when ascertained, defendant prays may be made part of this Answer by amendment thereto.

38.

Further answering, defendant avers that patents Nos. 1,402,309, 1,655,968, 1,763,523 and 1,815,733, and each of them were and are wholly invalid and void, because:

(a) The alleged improvements purported to be claimed in patents Nos. 1,655,968, 1,763,523, and 1,402,309 are so inter-related and so described and claimed in the respective patents that the subject matter thereof is doubly patented.

(b) The alleged improvements purported to be described and claimed in patents Nos. 1,655,968 and 1,815,733 are so inter-related and so described and claimed in the respective patents that the subject matter thereof is doubly patented.

39.

Further answering, defendant avers that said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick patents in suit are wholly invalid and void because the alleged inventions, improvements, or discoveries purported to be claimed therein are substantially different from any indicated, suggested or described in the original applications therefor; that subsequent to the filing of the applications for said Letters Patent, plaintiff and its predecessors in title became aware of the rights of others in and to the manufacture, use or sale of pistons not within the scope of said original applications; and that thereafter said applications were enlarged and expanded for the purpose of dominating the intervening rights of others.

40.

Further answering, defendant avers that said Mooers, Schmiedeknecht, Maynard, Jardine and Gulick

patents in suit were and are wholly invalid and void because the alleged inventions, improvements, or discoveries purported to be claimed therein are substantially different from any indicated, suggested or described in the original applications therefor; that subsequent to the filing of the applications of said Letters Patent, and after pistons were in public use or on sale in this country or available to the public in this country, plaintiff and its predecessors in title enlarged and expanded said applications with a view of dominating the intervening rights of others.

41.

Further answering, defendant avers that said Gulick patent in suit is wholly invalid and void, because said Edward J. Gulick did, after his alleged invention or discovery of the thing purported to be patented thereby, so unreasonably delay to make application for Letters Patent that the alleged invention, improvement or discovery, and every substantial or material part thereof was constructively abandoned to the public.

42.

Further answering, defendant avers that plaintiff, The Cleveland Trust Company, has from time to time acquired and accumulated Letters Patent, and applications therefor, purporting to claim certain alleged inventions, improvements or discoveries, which within the knowledge of plaintiff, The Cleveland Trust Company, had been invented or known or used by others prior to the alleged inventions or discoveries thereof by the patentees or applicants; that plaintiff, The Cleveland Trust Company, has unjustly intimidated the public with such Letters Patent, known by it to be wholly invalid and void, and that plaintiff, The Cleveland Trust Company, should, therefore, be denied the equitable relief prayed for in the Bill.

WHEREFORE, Defendant prays to be hence dismissed, and for its costs in this behalf most wrongfully sustained.

THE SCRIBER-SCHROTH COMPANY,
By KWIS, HUDSON & KENT,
Solicitors for Defendant.

Service of a copy of the foregoing answer acknowledged this 1st day of February, 1932.

EVANS & MCCOY,
Solicitors for Plaintiffs.

**NOTICE BY DEFENDANT, THE SCHRIER-
SCHROTH COMPANY OF INTENTION TO TAKE
DEPOSITIONS.**

(Filed February 15, 1932.)

[Case No. 4045.]

The Defendant hereby gives notice of its intention to take depositions in the above entitled cause, pursuant to the provisions of Equity Rule 47 and Sections 863, 865, 866 and 867 of the Revised Statutes of the United States.

THE SCHRIER-SCHROTH COMPANY, °
By KWIS, HUDSON & KENT,
Solicitors.

Cleveland, Ohio
February 15, 1932.

Service of a copy of the foregoing notice is acknowledged this 15th day of February, 1932.

EVANS & MCCOY,
Solicitors for Plaintiffs.

**SUPPLEMENTAL NOTICE BY DEFENDANT, THE
SCHRIBER-SCHROTH COMPANY, OF INTEN-
TION TO TAKE DEPOSITIONS ATTACHED TO
VENNER ET AL. DEPOSITIONS.**

(Filed January 9, 1933.)

[Case No. 4045.]

To Messrs. Evans & McCoy,
Bulkley Building,
Cleveland, Ohio,

Attorneys for Plaintiffs:

Please take notice that on Wednesday, April 27, 1932, at 10:00 A. M., Central Standard Time, the depositions of Charles Chadwick, a resident of Quincy, Illinois, William M. Venner and George Dorris, residents of St. Louis, Missouri, will be taken on behalf of the defendant herein, before Mildred Cook, a Notary Public, who is not of counsel for either of the parties to nor interested in this cause, at 2119 Railway Exchange Building, St. Louis, Missouri.

Upon the completion of the depositions of said witnesses, the deposition of Sidney D. Royalty, a resident of Jacksonville, Illinois, will be taken in Room No. 1, Morrison Block, Jacksonville, Illinois, before Lina Epperson, a Notary Public, who is not of counsel for either of the parties to nor interested in this cause. The exact time for taking the deposition of said Sidney D. Royalty will be fixed upon the completion of the depositions of the three first named witnesses.

The examination of said witnesses will be taken under Sections 639, 640 and 641 of Title 28 of the United States Code.

KWIS, HUDSON & KENT,

Attorneys for Defendant.

Cleveland, Ohio
April 22, 1932.

Service of a copy of the foregoing Notice of Taking Depositions is hereby acknowledged this 22nd day of April, 1932.

EVANS & MCCOY,

Attorneys for Plaintiffs.

NOTICE.

To Messrs. Evans & McCoy,
Bulkley Building,
Cleveland, Ohio,

Attorneys for Plaintiffs:

Supplementing the notice, dated April 22d, 1932, of taking depositions in St. Louis, Missouri and Jacksonville, Illinois, please take notice that, in addition to the witnesses whose depositions will be taken, at 2119 Railway Exchange Building, St. Louis, Missouri, pursuant to said notice, the deposition of Louis M. Stellman of Syracuse, New York, will be taken at said address following the depositions of the witnesses Chadwick, Venner and Dorris and before proceeding to Jacksonville, Illinois, for the purpose of taking the deposition of the witness Royalty.

KWIS, HUDSON & KENT,

Attorneys for Defendant.

Cleveland, Ohio
April 26, 1932.

Service of a copy of the foregoing Notice is hereby acknowledged this 26th day of April, 1932.

EVANS & MCCOY,

Attorneys for Plaintiffs.

**ORDER FOR REFERENCE TO AND APPOINTMENT
OF SPECIAL MASTER.**

(Entered November 7, 1932 by Paul Jones, Judge.)

[Case No. 4045.]

This cause coming on to be heard upon motion and application of Plaintiffs to refer the issues, both of law and fact, to a Special Master for his investigation, consideration, findings, conclusions and report, and it appearing that exceptional conditions exist in this cause

and in the business of the Court, and it appearing that this cause is at issue, and that counsel for both parties have heretofore stipulated that the cause may be tried at any time after June 20th, 1932, at the convenience of the Court, and it appearing that the cause will take considerable time for the trial thereof, therefore:

It is ordered that this cause, with its pleadings, evidence, proofs and exhibits, including the testimony, exhibits and all other matter heretofore filed, taken, submitted, offered or adduced, be, and the same is hereby referred to Wm. B. Woods, Esq., Special Master, to hear witnesses and counsel, to receive and consider testimony, affidavits, exhibits and other proofs including that heretofore filed, to examine and consider pleadings, proofs, briefs, arguments and any and all other matters relating to the questions involved or the issues raised in this cause, and rule on the admissibility of evidence, but to preserve such evidence as counsel may demand which the Special Master deems inadmissible, together with his ruling thereon for ultimate and final ruling by this Court, to observe such tests and experiments as the parties may perform or cause to be performed, and as he, with reasonable convenience, is able to and considers proper, and to hold his sessions within the District and Division of this Court at such times as he shall direct and thus to hear and consider all of the proofs and arguments pertinent to the issues of law and fact arising in this cause; and

It is further ordered that the said Special Master herein shall file and report to the Court his conclusions of law and findings of fact, together with all the evidence and exhibits presented, offered and/or considered by him and to file with this Court his report and opinion, giving his reason and authority for his findings and conclusions, along with his recommendations concerning the relief demanded and/or concerning the final disposition of this cause, all subject to the final, ultimate and full review and determination by this Court. Exceptions to defendant.

JONES,

United States District Judge.

Service of a copy of the foregoing Motion and proposed Order and the Memorandum attached thereto acknowledged this 14th day of September, 1932.

KWIS, HUDSON & KENT,

Solicitors for Defendant.

**STIPULATION OF PLAINTIFF AND DEFENDANT,
THE SCHRIER-SCHROTH COMPANY, CON-
SOLIDATING CAUSE NO. 4045 WITH CAUSES
NOS. 4046 AND 4047 FOR TRIAL.**

(Filed January 11, 1933.)

[Case No. 4045.]

It is hereby stipulated and agreed as follows, by and between the parties hereto:

1. That the above-entitled case may be tried with both of the following cases:

The Cleveland Trust Company,
Chrysler Corporation,

vs.

The Aberdeen Motor Company.

The Cleveland Trust Company,
Chrysler Corporation,

vs.

The F. E. Rowe Sales Company.

} Equity No. 4046.

} Equity No. 4047.

2. That the evidence adduced in any one of the three above-mentioned cases, whether a deposition, exhibit, or any other form of evidence, may be used in either or both of the other above-mentioned cases with the same effect as if adduced therein.

3. That each party furnish to the other party, a copy of all depositions and photostatic copies of all paper exhibits taken and offered by it, without expense to the other party to whom such depositions and copies of the depositions are furnished, but that said copies and photostats which are so furnished are not to be made part of the taxable cost in this cause. This Section 3 does not apply, however, to the records in interference cases in which any of the applications on which any of the patents in suit issued were involved.

4. That the Exhibits referred to in the depositions may be retained in the custody of counsel first producing such exhibits, subject to the inspection of opposing counsel upon request and reasonable notice, said exhibits to be preserved in the same condition as when so referred to and to be produced in Court on or before the day of the hearing.

5. That each party may introduce uncertified printed or photostatic copies of any United States or foreign patent and of any publication, copies of United States Patent Office records, including file wrappers and contents and records of interferences in the Patent Office, with the same force and effect as if the originals or duly certified copies thereof were used, and subject, however, to the right of either party to show by proper proof any inaccuracies either in the dates or otherwise which may appear on said copies by comparison of the original documents with such copies or otherwise; all subject to any objection except that the copies are not the original or certified.

EVANS & MCCOY,

Counsel for Plaintiffs.

KWIS, HUDSON & KENT,

Counsel for Defendant.

St. Louis, Missouri,
April 27, 1932.

It is so Ordered.

JONES, U. S. D. J.

ORDER GRANTING STIPULATION CONSOLIDATING EQUITY CAUSE NO. 4045 WITH CAUSES NOS. 4046 AND 4047 FOR TRIAL, ETC.

(Entered January 11, 1933 by Paul Jones, Judge.)

[Case No. 4045.]

Pursuant to stipulation filed herein it is ordered:

1. That the above case be tried with Equity cases No. 4046 and No. 4047.

2. That the evidence adduced in any one of the three above-mentioned cases, whether a deposition, exhibit, or any other form of evidence, may be used in

either or both of the other above-mentioned cases with the same effect as if adduced therein.

3. That each party furnish to the other party, a copy of all depositions and photostatic copies of all paper exhibits taken and offered by it, without expense to the other party to whom such depositions and copies of the depositions are furnished, but that said copies and photostats which are so furnished are not to be made part of the taxable cost in this cause. This Section 3 does not apply, however, to the records in interference cases in which any of the applications on which any of the patents in suit issued were involved.

4. That the Exhibits referred to in the depositions may be retained in the custody of counsel first producing such exhibits, subject to the inspection of opposing counsel upon request and reasonable notice, said exhibits to be preserved in the same condition as when so referred to and to be produced in Court on or before the day of the hearing.

5. That each party may introduce uncertified printed or photostatic copies of any United States or foreign patent and of any publication, copies of United States Patent Office records, including file wrappers and contents and records of interferences in the Patent Office, with the same force and effect as if the originals or duly certified copies thereof were used, and subject, however, to the right of either party to show by proper proof any inaccuracies either in the dates or otherwise which may appear on said copies by comparison of the original documents with such copies or otherwise; all subject to any objection except that the copies are not the original or certified.

**AMENDMENT TO ANSWER OF DEFENDANT,
THE SCHRIBER-SCHROTH COMPANY.**

(Filed April 19, 1933.)

[Case No. 4045.]

Leave having been granted by the Master, the Answer in the above-entitled cause is hereby amended as follows:

Add the following paragraphs:—

43.

Further answering, defendant avers that the Gulick patent in suit 1,815,733 is wholly invalid and void as to claims 1, 4, 15, 25, 27, 28, 33, 34, 36, 38, 42 and 43, because the alleged invention, improvement or discovery purported to be patented thereby and every substantial and material part thereof

A. Was published, described or patented prior to the alleged invention or discovery thereof or more than two years prior to the application for said patent, by the following Letters Patent and the application therefor:

Schoengarth 1,174,092, patented March 17, 1916, on application filed October 1, 1915.

B. Because more than two years prior to the effective filing date of the Gulick patent, the same was publicly used or on sale in this country by the following person, at and residing at the following place:

Walter L. Schoengarth, Ironwood, Mich.
Ironwood, Mich.

C. Because prior to the alleged invention thereof by said Gulick, the same was developed or known or used by the following person in this country and residing at the following place:

Walter L. Schoengarth, Ironwood, Mich.

D. Because prior to said alleged invention thereof by said Gulick, the same was conceived by another in this country who was using reasonable diligence in adapting and perfecting the same, namely by the following person at and residing at the following place:

Walter L. Schoengarth, Ironwood, Mich.
Ironwood, Mich.

THE SCHRIBER-SCHROTH COMPANY,

By KWIS, HUDSON & KENT,

Solicitors for Defendant.

Cleveland, Ohio,

**STIPULATION OF PLAINTIFF AND DEFENDANT,
THE SCHRIBER-SCHROTH COMPANY, RE NAR-
RATIVE OF TRANSCRIPT.**

(Filed October 26, 1934.)

[Case No. 4045.]

It is hereby stipulated by and between the respective parties to the above cases by their counsel as follows:

That the Plaintiffs need not file separate narrative forms of the evidence in each of the above entitled cases, but that it will be sufficient to file a narrative form in one cause and a reference thereto in each of the other two causes.

Wm. C. McCoy,
Counsel for Plaintiffs.

KWIS, HUDSON & KENT,
Counsel for Defendants.

It is so ordered.

JONES, *United States District Judge.*

Cleveland, Ohio,
October 26, 1934.

**ORDER GRANTING STIPULATION OF PLAINTIFF
AND DEFENDANT THE SCHRIBER-SCHROTH
COMPANY, FOR FILING NARRATIVE FORM
TESTIMONY IN ONE CAUSE WITH REFER-
ENCE THERETO IN EACH OF OTHER TWO
CAUSES.**

(Entered October 26, 1934 by Paul Jones, Judge.)

[Cases Nos. 4045-6-7.]

Pursuant to stipulation filed herein, it is ordered that the plaintiffs need not file separate narrative forms of the evidence in cases Nos. 4045, 4046 and 4047, but that it will be sufficient to file a narrative form in one cause and a reference thereto in each of the other two causes.

**ORDER APPROVING NARRATIVE FORM OF
TESTIMONY.**

(Entered February 26, 1935 by Paul Jones, Judge.)

[Case No. 4045.]

Now comes the plaintiffs and present to the Court their certain narrative form of testimony taken at the trial of this cause which being found by the Court to be true, is allowed, signed and sealed, and is hereby ordered to be filed in this cause.

**ACKNOWLEDGMENT OF SERVICE OF NARRATIVE
FORM OF TESTIMONY.**

(Filed February 26, 1935.)

[Case No. 4045.]

Service of a copy of the within Narrative Form of Testimony in the above entitled suits, on appeal, acknowledged this 21st day of February, 1935, and the Narrative is hereby approved by Defendants.

JOHN H. BRUNINGA,

*Attorney for Defendants.***NARRATIVE FORM OF TESTIMONY.**

(Filed February 26, 1935.)

It was agreed between counsel that the exhibits would be marked as offered in Cleveland Trust Co. and Chrysler Corporation vs. Aberdeen, in Equity 4046.

By Mr. Richey: I offer the patents in suit as Plaintiffs' Exhibits 2 to 6, inclusive.

I will offer in evidence as Plaintiffs' Exhibit 1, the piston referred to in the Answer.

A very large number of claims have been infringed, and we have picked out certain claims upon which we rely. In the Gulick patent we charge infringement by the piston which we have called the Sterling piston, and an example of which is in Exhibit 1, claims 1, 11, 12, 13, 15, 18, 30, 33, 35, 38, 41, 42, and 43.

Now, we charge infringement by the Ray Day piston of claims 1, 15, 22, 27, 28, 29, 30, 33, 36, 37, 38, 42, and 43.

Of the Jardine patent, we charge infringement by the Sterling piston, exemplified by Exhibit 1, when the slit is completed of claims 1, 2, 4, 5, 6, 7, 8, 9, 10, and 11.

We charge infringement by the Ray Day piston of claim 1.

In the Maynard patent, we charge infringement by the Sterling piston of claims 1 to 11, inclusive, that is, all of the claims of that patent.

Of the Mooers patent, we charge infringement by the Sterling of claims 1, 2, 6, and 10. We had notified you of claim 9, but we are dropping that out.

By the Ray-Day piston we charge infringement of claims 3, 4, 8, and 11 of the Mooers patent.

Of the Schmiedeknecht patent, we charge infringement by the Sterling of claims 1 and 3.

PLAINTIFF'S TESTIMONY.

W. F. BURKER, a witness called by Plaintiffs, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. McCoy.

I am W. F. Burrer, aged 45, President, Treasurer and General Manager of Aberdeen Motor Supply Company, residing at 3558 Antisdale Avenue, Cleveland Heights, Ohio.

Q. I hand you a piston marked Plaintiffs' Exhibit 1 and ask you whether or not you sell pistons identically the same as this piston except with the longitudinal slot in the thrust face completed at the top and bottom.

Mr. Bruninga: I am willing to agree to that. I have told Mr. McCoy we agreed to that.

Mr. McCoy: And will you agree, Mr. Bruninga, that this defendant, the Aberdeen Motor Supply Company, sold pistons with the slots completed, between the date of issue of the patents in suit and the filing of the bill of complaint?

Mr. Bruninga: Yes.

Mr. McCoy: Will you also agree that the paper marked Plaintiffs' Exhibit 7 is a true and correct copy of an instruction sheet that is given to the purchaser of the pistons like Plaintiffs' Exhibit 1 in suit?

Mr. Bruninga: Yes. And I agree to that as to all of these three defendants, if that is all.

Mr. McCoy: The instruction sheet is offered in evidence as Plaintiffs' Exhibit 7.

The Master: It may be received.

(Narrative continued) Plaintiffs' Exhibit 8 piston is known to the trade as a Ray Day piston. We sell

pistons like Plaintiffs' Exhibit 8 with the longitudinal slot in the thrust face of the piston completed, and we sell pistons identically the same except that the slot is uncompleted.

Mr. McCoy: Plaintiffs' Exhibits 8 and 9 are offered in evidence as Exhibits with the marking by which they are identified.

The Master: They may be received.

Ray Day pistons like Plaintiffs' Exhibits 8 and 9 had been sold by Aberdeen Motor Supply Company for about two years, and these Ray Day pistons like Exhibits 8 and 9 were sold continuously after we started to handle such pistons.

The witness is handed the advertisement Plaintiffs' Exhibit 10A.

Mr. McCoy: Will you admit that advertisements represented by Plaintiffs' Exhibit 10A have been circulated to the trade by one or more of these defendants?

Mr. Bruninga: I don't know whether by one or more of these defendants. I say that one has been in circulation somewhere.

A poster like Plaintiffs' Exhibit 12 is prominently displayed in the Aberdeen Motor Supply Company's place of business.

Mr. McCoy: The poster is offered in evidence as Plaintiffs' Exhibit 12.

The Master: It may be received.

CROSS EXAMINATION by Mr. Bruninga.

It was not until February or March of 1932 that Aberdeen Motor Supply Company started selling Ray Day pistons like Exhibits 8 and 9.

I have given verbal instructions to complete the split in pistons like Plaintiffs' Exhibit 9. I sold a piston something like the strut type piston, Defendant's Exhibit AAA. Aberdeen Motor Supply Company sales were to independent repair shops, car dealers, car distributors, including trucks, and Aberdeen Motor Supply Company pushes the sale of Ray Day pistons like Exhibits 8 and 9, more than other pistons.

(Examination closed.)

CLARENCE A. SCHROTH, a witness called by Plaintiffs, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. McCoy.

I am Clarence A. Schroth, age 41, Vice President and General Manager of The Schriber-Schroth Company, residing at 2250 Fourth Street, Cuyahoga Falls, Ohio.

CROSS EXAMINATION by Mr. Bruninga.

This company sold pistons like Exhibit 1 to garages and repair shops and it discontinued selling such pistons after this suit was started against ..

(Examination closed.)

F. E. ROWE, a witness called by Plaintiffs, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Richey.

My name is F. E. Rowe. I am of mature age, and am president and treasurer of F. E. Rowe Sales Company. I live at 45 South Walsh, Akron, Ohio.

My company sold pistons like Plaintiffs' Exhibit 1, and finished the pistons themselves by cutting the longitudinal slot through them. The F. E. Rowe Sales Company also sold pistons like Plaintiffs' Exhibit 9, and when such pistons were ready to leave the shop, the longitudinal slots were cut through like Exhibit 8. Ray Day pistons like Exhibits 8 and 9 have been sold by my company continuously for about three years.

CROSS EXAMINATION by Mr. Bruninga.

The F. E. Rowe Sales Company sells to garages, fleet owners, and manufacturing concerns, and have outside men to take orders for pistons, and they particularly stress the sale of Ray Day pistons but do not stress the sale of Sterling pistons. The sale of Sterling pistons is a price proposition and we have always been able to buy Sterling pistons cheaper than any other piston that they handled or might have handled. Within the last thirty days I think Ray Day has met the Sterling price.

Besides Sterling pistons, like Exhibit 1, my company also sells Sterling pistons like Defendants' Exhibit BBB, for 6-cylinder Chevrolet cars, and have sold such pistons continuously for about 21½ years. These pistons were brought from Sterling Products Corporation.

Mr. Bruninga: I offer in evidence Defendants' Exhibit BBB.

The longitudinal split in Exhibit BBB pistons is completed before the pistons leave The F. E. Rowe Sales Company. Sterling makes only Ford and Chevy sizes, as I understand it. We sell them both.

RE-CROSS EXAMINATION by Mr. Bruninga.

I cannot answer as to whether my company handled Exhibit BBB pistons before this suit was brought against my company.

By Mr. Bruninga: I agree that this particular defendant (F. E. Rowe Sales Company) of which the witness is an official furnishes the piston (Defendants' Exhibit BBB) with the skirt split all the way up and down.

By the Witness: We finish the split ourselves.
(Examination closed.)

CHARLES W. WHITNEY, called as a witness by Plaintiffs, who being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. McCoy.

My name is Charles W. Whitney; age 30; residence 3470 North Cliff Road, Cleveland Heights, Ohio. I am employed as a clerk by The Cleveland Trust Company, and have been so employed for nine and a half years. That is the plaintiff in this cause.

The Cleveland Trust Company receives royalties on a group of piston patents, and it receives such royalties on pistons.

Mr. Bruninga: I object to that, unless they are royalties on piston patents involved in this case.

The Master: I think that is a proper objection.

Mr. Richey: Well, we will connect it up, your Honor. We can't do everything with this witness.

The Master: As a preliminary question it may stand, then.

(Narrative continued) It receives royalties on just the one group of piston patents. I know this from the reports that we receive from the licensees. We receive

these reports from the Aluminum Company of America and Bohn Aluminum & Brass Corporation. These reports that we receive refer to the sub-licensee of Aluminum Company of America, the Aluminum Industries, Incorporated, of Cincinnati, Ohio. I know of former concerns that have paid royalties on pistons to The Cleveland Trust Company. They are Walker M. Levett Company, National Piston Company, I believe. There is the Kant Skore Company, which I now understand to be the Aluminum Industries, Incorporated, of Cincinnati.

The direct licensees report to us the number of pistons sold by them. These are the parties that I have named.

Mr. Bruninga: I would like to make an objection at this time that the best evidence is at least one of the reports.

(Narrative continued) I know this from the reports that we receive from the licensees that are under my control and supervision.

The Master:—The reports themselves are the best evidence.

Mr. Richey: We are willing to produce the reports for inspection of the other side, but we think for the convenience of the Court this witness can testify as to a certain summary he has taken from the report. We want to prove the number of pistons.

The Master: You may offer that statement and let counsel on the other side examine the original documents that you have. You can shorten this by putting in the tabulation, can't you?

Mr. McCoy: Yes.

(Narrative continued) I have, at your request, examined these reports, and can tell the total number of pistons on which royalties have been paid to The Cleveland Trust Company. I have such a tabulation with me. (Witness produces same.) This report covers the period from 1924 to the present time, including the three-quarters of 1932. From this report, the total number of pistons on which royalties have been paid to The Cleveland Trust Company during the period covered by the tabulation I have produced, is 90,397,709.

The royalties paid to The Cleveland Trust Company on these pistons is one cent per piston; the aggregate amount paid to The Cleveland Trust Company being \$903,977.09.

The number of pistons on which royalties have been paid by years, is as follows: 1924, 2,335,308; 1925, 5,775,392; 1926, 5,128,482; 1927, 5,824,029; 1928, 20,981,043; 1929, 20,786,112; 1930, 14,198,296; 1931, 9,321,967; and three-quarters of 1932, 6,047,080.

Mr. McCoy: The tabulation produced by the witness is marked Plaintiffs' Exhibit 13 and is offered in evidence.

Mr. Bruninga: I must object to that unless we have a chance to inspect these royalty reports.

Mr. Richey: All right, when do you want to see them?

The Master: This will be received subject to the objection that defendants' counsel now makes, and received subject to correction later if there are any changes or observations he wishes to make after examination.

Mr. Bruninga: Second, that there has been no licenses produced at all to show what patents are covered by these royalties. This is put in for the purpose of showing commercial use, possibly acquiescence, and we are entitled to see the license, to see what they really amount to.

Mr. Richey: Well, you are not entitled to see the licenses. You are entitled to proof to show that the pistons that were made by these licenses on which these royalties were paid were such pistons as are involved or come within these patents, and you are entitled to see these reports, and we will be glad to show them to you. We didn't bring them down here because there are so many of them.

Mr. Bruninga: I believe I am entitled to see the licenses.

Mr. Richey: We haven't testified to the contents of the licenses.

The Master: How is anyone to know these pistons are made subject to any contract?

Mr. Richey: The licenses don't show that. We have to put an expert on.

The Master: The report don't show it, either.

Mr. Richey: I know, but we are going to put on a man to show these are the pistons under which the royalties were paid.

The Master: If that is connected up it is competent later.

Mr. Richey: We are going to connect it up. We have a man who knows the pistons and we have a man who is an accountant.

The Master: It will be received subject to the objection at this time.

Mr. Bruninga: I understand, subject to my objection, I am entitled to see the licenses, not take somebody else's word for it, and that these are royalties paid under the patents and not for something else.

The Master: I will not pass on that subject whether you are entitled to see the licenses at this time. If before we close the case it is apparent they are needed, I will rule on that subject.

Mr. Richey: Direct examination closed.

CROSS EXAMINATION by Mr. Bruninga.

These reports come to me.

I work under R. A. Malm, Vice President in charge. Mr. Perfler is an assistant trust officer in the same department that I am in. I believe he is familiar with the trust estate. He doesn't have charge of it; he is under Mr. Malm. He is accountable to Mr. Malm, as I understand it. Mr. Malm is senior officer. Mr. Malm has charge of the department. Mr. Perfler and myself, of course, would be under him, as I understand it. I am under Mr. Malm. Both Mr. Malm and Mr. Perfler are in town. They will be here for a couple of days.

Mr. Bruninga: Will counsel produce them if I want them later on?

Mr. Richey: Why, no, I can't guarantee to produce them. You can subpoena them.

Mr. Bruninga: That is all I want to know, if you can produce them or if I would have to subpoena them.

Thereupon, the plaintiffs called as a witness, ZAY JEFFRIES, who, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Richey.

Q. Will you state your name, Doctor? A. Zay Jeffries.

Q. Do you live in Cleveland? A. Yes, in Shaker Heights.

Q. And you are of mature age? A. Yes.

Q. Will you state how you are employed at the present time? A. I am consulting metallurgist for the Aluminum Company of America, with offices at the Harvard Avenue plant in Cleveland; chairman of the Technical Committee of the Incandescent Lamp Department of the General Electric Company, with an office at Nela Park, in Cleveland; and president of the Carboloy Company, a subsidiary company of General Electric Company.

Q. How do you divide your time among those companies? A. Well, I give approximately half my time to the Aluminum Company and half to the General Electric Company.

Q. Now, will you state your experience and your education and other qualifications in connection, particularly in connection with the subject matter to which this suit relates, naming any awards you have had in connection with societies related to the subject matter? A. I received the degree of Bachelor of Science in mining engineering, and later the degree of metallurgical engineer, and still later the honorary degree of Doctor of Engineering from the South Dakota School of Mines. I have also received the Degree of Doctor of Science, majoring in metallurgy from Harvard University. I taught metallurgy at Case School of Applied Science in Cleveland from 1911 to 1917. During that time I did considerable consulting work on various metallurgical and engineering problems for the National Electric Lamp Association, which is part of the General Electric Company, for the Lincoln Electric Company, and Aluminum Castings Company. My work with the Aluminum Castings Company began in 1915, and that connection has continued ever since, in one form or another. The Aluminum Castings Company was reorganized after 1915 and became Aluminum Manufactures, Incorporated, and then Aluminum Manufactures, Incorporated, became part of the United States Aluminum Company, at a still later date. I left the teaching work entirely in 1917 to give all of my time to the consulting and engineering work with the two companies, the Aluminum Castings Company and General Electric Company. At that time I assumed the directorship of research for Aluminum Castings Company. I was also director of research for Aluminum Manufactures, Incorporated. The research laboratories of Aluminum Manufactures, Incorporated,

were consolidated with the research laboratories of Aluminum Company of America, so at that time I joined the Aluminum Company of America staff. That was, as I recall it, in 1920.

In connection with my work with the Aluminum Castings Company and its successor company, and Aluminum Company of America, I have had considerable to do with the aluminum piston art, not only from the standpoint of manufacture but also from the standpoint of the testing of such pistons. The so-called dynamics laboratory at Harvard Avenue was for a time under my direction, and for years I have been in fairly close touch with the piston tests in that laboratory.

With reference to professional societies, I am a member of ten or more of the national engineering and scientific societies, having been president of the American Society for Steel Treating, and chairman of the Institute of Metals, Division of the American Institute of Mining and Metallurgical Engineers. I am a member of the Society of Automotive Engineers, and have been a member of the Non-Ferrous Metals Division of that society for perhaps 12 or 14 years. I have been chairman of the division for about five years during that period. I have also been on the executive committee of the American Society for Testing Materials. I am also a member of the Materials Committee for Aircraft of the National Advisory Committee of Aeronautics, and a member of the sub-committee on metals of that committee. Insofar as honors are concerned, I delivered a number of invitational lectures, such as the Robert Henry Thurston Lecture of the American Society of Mechanical Engineers; the Henry Marion Howe Lecture of the American Institute of Mining and Metallurgical Engineers; and the Campbell Lecture of the American Society for Steel Treating. I was also awarded the James Douglass gold metal by the American Institute of Mining and Metallurgical Engineers for distinguished service in non-ferrous metallurgy.

I have previously testified in a number of patent suits, including the ductile tungsten suit, the suits on the Langmuir gas filled lamp, the Just & Hanaman patent on tungsten as a filamentary body. I have testified for the Fulton Company on sylphon cases, and for the Aluminum Company of American in patent suits relating to the manufacture of aluminum alloy pistons.

Q. Will you describe briefly the construction and operation of an internal combustion engine, using this large drawing which I show you in your explanation, if you wish, and explain it with reference to a piston and its operation? You can put in any numerals on the drawing what you wish. The drawing I ask to be marked for identification as Plaintiffs' Exhibit 14.

I will just offer it in evidence as Plaintiffs' Exhibit 14 and you can refer to it by that number.

A. Exhibit 14 is a drawing showing a vertical section through an internal combustion engine of the water cooled type, the section being taken through the axis of one of the cylinder barrels. It is not a true sectional drawing inasmuch as the connecting rod is not sectioned but shown in vertical plan view. I will indicate by letter A a section of the combustion chamber. It is in this chamber that the mixture of heavy fuel is compressed and ignited and it is by virtue of the heat generated by ignition and the burning of the gas that the pressure in the combustion chamber becomes great and the piston is forced downward. The piston is shown in section and indicated as B. The other parts of the combustion chamber, with the exception of the valves, indicated by C, are stationary. The valves are stationary and closed at the time of the explosion so that at that time only the piston is movable. Therefore the entire force of the high gas pressure is available to move the piston, which in turn, by means of the connecting rod, D, transmits its motion by means of a crank E to the crankshaft, which in turn transmits its rotary motion by a gear system to the wheels of the automobile or to the propeller of a marine motor or other driving mechanism. The piston then has a reciprocating motion, that is, the downward movement is equivalent to twice the length of the crank arm. When the crank reaches its lowest position, the piston has traveled downward in the cylinder barrel as far as it can go. The cylinder barrel is indicated by F. The piston must perform many functions. First, it must take the blow of the explosion and be subjected to high pressure at the uppermost part, which is called the piston head, indicated by C, and at the same time be subjected to high temperature, so that the piston head must resist not only the mechanical force but also the temperature of the burning gases. It is essential that the force of the explosion be transmitted to the running gear of the car rather than expend itself by escaping from the chamber

through leaks. The piston therefore must also serve as a seal against the leakage of the gases from the combustion chamber into the lower part of the engine or the crank chamber. The piston must also act as a bearing. It is a moving part. During the explosion stroke, with considerable pressure at the head of the piston, the tendency is for the skirt of the piston, indicated by H, to be thrust strongly against one side of the cylinder barrel. That side depends on the direction of rotation of the crankshaft, and hence the direction of cocking of the connecting rod at any particular time. If the rotation is accomplished counter-clockwise, as shown on the present diagram, the tendency would be for the piston to be thrust hard against the right-hand side of the cylinder barrel. The piston must do all of these things at the same time and function even though different parts attain different temperatures. The direct heat of the explosion is applied at the head of the piston, so the head becomes the hottest portion. The bottom of the skirt is usually the coldest portion. In an ordinary piston the temperature usually decreases from the head towards the bottom of the skirt. The piston must not bear so hard in a cylinder as to consume too much power, and in any case it must not seize or stick. In the pleasure cars, and particularly during the last ten or twelve years, it must not make any noise, that is, it must not slap.

I think that covers in a brief way the function of the piston in the motor.

Q. Will you explain more carefully what you mean by sticking, scoring, slapping, oil pumping and clearance? A. There is one thing I neglected to mention, which was that the piston must also act as a seal against the transfer of oil in an upward direction from the cylinder into the combustion chamber, and that operation is known as oil pumping. It also must act as a seal against the dripping of any liquid gasoline or condensed moisture from the combustion chamber down into the crank chamber. The term "seizing" or "sticking" is applied to the condition of too tight a fit between the piston and the cylinder barrel. The motor parts are made of metal. When the cylinder barrel is made of cast iron, as is usual, and as has been used for many years, the expansion of the cylinder barrel is relatively small because the expansion of cast iron is relatively small. The expansion is still further retarded by the cooling effect of the water in the water jacket. The piston always

operates hotter than the cylinder. Therefore even when the piston itself is made of cast iron, as was usual in the earlier days, some clearance must be allowed in the fitting of the piston in the cylinder. The piston is therefore machined to a smaller diameter than the diameter of the barrel of the cylinder. That clearance varies in different parts of the piston; it was more near the head of the piston than in the skirt portion. It was more near the head because the head got hotter and expanded more. It was less in the skirt portion because the skirt portion remained cooler and expanded less. The amount of clearance required in the cast iron piston was quite small, being on the order of .001 inch per inch of diameter of the cylinder barrel. Thus a 3" diameter piston would be allowed a clearance of approximately .003". That clearance is in the skirt portion. The clearance near the piston head would be something on the order of .015", or sometimes more. A cast iron piston with such clearance will run in a cylinder, if properly lubricated and properly cooled without sticking or seizing, and without slapping. As the piston wears away or as the cylinder wears, the clearance may increase, and even a cast iron piston in a cast iron cylinder may make noise at some stage in the life of the motor. But, generally speaking, the question of fit is relatively simple when a cast iron piston is used in a cast iron cylinder.

About 1915 there came into use the aluminum alloy piston, and this material has about twice the coefficient of expansion as cast iron. The difficulties due to the excess of expansion of the piston over that of the cylinder barrel were tremendously multiplied. It was found practically impossible to fit an aluminum alloy piston in a cast iron cylinder so that it would not stick or seize when the motor became hot, and at the same time be free from the noise of piston slap when the motor was cold. The aluminum alloy, however, had two great advantages. It had a higher heat conductivity and therefore permitted the heat to escape from the piston head at a faster rate than in the iron piston; and it was also very light in weight, which was an advantage in a part which must reciprocate sometimes as much as 30 to 40 times, 50 or even as high as 60 or more times in one second, in extreme cases. So that in spite of the higher coefficient of expansion, there were aluminum pistons used at that time which were fitted with considerably greater clearance than the cast iron pistons. Generally speaking, approxi-

mately twice the clearance was required in the original fitting. Now, the greater clearance brought also another problem, that is, in addition to slapping. It also made it more difficult to seal the cylinder barrel against particularly the passage of oil from the downward direction up into the combustion chamber. The job is better done with small clearance than it is with large clearance.

Q. What is the relation between weight of aluminum alloy and iron? A. The aluminum alloy weighs, volume for volume, approximately 40% that of iron.

Q. And what is the relation between the coefficient of heat conductivity of the two metals? A. The aluminum alloy conducts heat about three times as well as cast iron.

Q. What is the effect of the reciprocation of a heavy piston in a pleasure automobile, say? A. The effect is to increase the so-called inertia forces, that is the forces due to the mass itself, at all of the bearings. That is, the piston must itself be started and that starting action is resisted by its weight. It also, when it reaches a high velocity, must be stopped, and that extra force of stopping is evident on the bearings, and in general that effect is to increase the vibration of the motor, so that the vibration becomes less as the piston becomes lighter.

Q. And what is the effect of low heat conductivity, such as that of iron? A. The effect is to cause the piston head to operate at a high temperature, which favors the accumulation of carbon deposit on the cylinder head and in the combustion chamber, and it also may promote the ignition of the charge before the spark plug is ready to cause that ignition.

Q. How long prior to the use of aluminum for pistons was it known that aluminum had these superior properties to iron which you have mentioned? A. Many years.

Q. Now, what if any efforts were made, commercially, that you know of to obviate or lessen the disadvantages of the iron piston which you have mentioned? A. Efforts have been made almost since the beginning of the automobile industry to reduce the weight of the cast iron piston or to otherwise obviate the difficulties due to the properties of cast iron. I don't know that a better brief recital of some of the attempts could be made than a number of the references.

Q. I won't ask you about the prior art, at least at this time. I had in mind what you knew commercially,

independently of the prior art patents. They will be taken up in rebuttal. A. Several schemes were used, such as making skeleton pistons in place of the full trunk skirt. Also it was suggested to use aluminum alloy head and cast iron skirt, thereby gaining the advantages of heat conductivity of aluminum for the head and the advantages of cast iron as regards its low thermal expansion for the skirt. Also rotary type engines were worked on to get rid of the reciprocation entirely. Also very thin walled castings were proposed and tried, and also pistons were made up, or attempts were made to solve those difficulties by pressing into shape very thin walled steel sheets, suitably braced on the inside.

Q. Did any of these efforts meet with success? A. None of them.

Q. You spoke of aluminum pistons coming in about 1915. How did they compare in structure with the iron piston such as shown on that Exhibit 14? A. They were of the same general type as the iron piston.

Q. That is the trunk type? A. Yes.

Q. Now, for what character of vehicles were they used? A. They were used in automobile engines and aircraft engines.

Q. What about the trucks? A. And trucks.

Q. To what extent, in a general way, were they adopted in automobile engines? A. They were used quite widely between 1915 and 1920 or 1921, that is, a considerable number of the original car manufacturers incorporated at one time or another aluminum pistons as a standard product.

Q. And you say they were objectionable for certain reasons? A. Yes, they were. They were objectionable for still another reason beyond what I have mentioned. The aluminum alloy did not have as good a bearing surface against the iron cylinder wall as the cast iron. That was especially true when the lubrication was bad or when the finish of the cylinder was bad. But the two main troubles at that time were sticking, seizing, if the pistons were fit too closely, and slapping if the pistons were fit too loosely.

Q. Now, what happens when a piston slaps? A. It is thrust against one side of the cylinder barrel and merely makes a noise in the motor.

Q. A big noise or little noise? A. Well, it is quite a little noise. To the driver of the car, at any rate, at the beginning it is not very noticeable, and to the auto-

motive engineer, he uses a stethoscope to discover such noises. But, nevertheless, as improvements have come along and standards have increased, the noiseless piston became a practical necessity. These noises were tolerated in the earlier days.

Q. And what happens when the piston sticks or scores in the cylinder? A. The least that can happen is to have the piston act as a brake on the motor and merely stop it, and after cooling off, if one is lucky, he may be able to start the motor again and drive away, but usually the piston or the cylinder, or both, are scored and sometimes the seizure takes place with such rapidity that the connecting rod is broken, or the piston is broken, and the motor is practically wrecked.

The Master: We will recess at this time until 9:30 tomorrow morning.

(Thereupon an adjournment was taken to the following day, whereupon, at 9:30 A. M., Thursday, January 19, 1933, the hearing was resumed.)

(Appearances the same as last noted.)

Mr. Bruninga: May it please the Court, the day before yesterday when the assignment papers were offered in evidence, I said I wanted to look over them and reserve objection. I am prepared to do that now, but I am just wondering whether it would not be well to wait until this witness gets through.

Mr. Richey: Or wait until Mr. McCoy gets here.

Q. Doctor, you talked yesterday about clearance. I will show you two drawings which I have marked for identification Plaintiffs' Exhibits 15 and 16. Would you explain what you mean by clearance on those drawings, putting the necessary reference numerals on them? A. Considering Exhibit 15, this is merely a cross-section of a cylinder wall and a piston wall inside of the cylinder wall. The cylinder and piston are indicated by the words "cylinder" and "piston"; and the word "clearance" also is printed on the exhibit. The piston in Exhibit 15 is shown concentric with the cylinder. The clearance would be then twice the distance between the outside of the piston wall and the inside of the cylinder wall. In the case of Exhibit 16, the clearance is shown greatly

magnified, and mostly on one side, that is the piston is in this exhibit supposed to be pressed fairly tightly against the cylinder wall on the right-hand side, so that the total clearance appears on the left-hand side. The clearance is the difference in diameter between the piston and the cylinder wall. It is not always possible to refer to it in such simple terms because of the out-of-roundness of pistons, boss reliefs, and so forth, but these drawings both very greatly magnify the actual clearance. The actual clearance on a three inch to four inch diameter piston is only in the neighborhood of two or three thousandths of an inch.

Mr. Richey: I offer those in evidence as Plaintiffs' Exhibits 15 and 16.

The Master: They will be received.

Q. Now, Doctor, to what extent have you been associated with this aluminum piston business since its inception, I mean in a business way with respect to the extent or lack of extent of use of these aluminum pistons?

A. I first came in contact with the aluminum piston business in December, 1915, when I became associated in a consulting way with the Aluminum Castings Company of Cleveland. They were manufacturing aluminum alloy pistons in permanent molds in Buffalo. I went to Buffalo at that time to look at the piston process and at the molds, with the idea of assisting the Aluminum Castings Company in connection with the patent specifications in connection with the molds and processes. I later became associated with the Aluminum Castings Company in general research activities and I have been active continuously since December, 1915, with the Aluminum Castings Company, or its various successors, working on pistons. I have not only worked in connection with the factory in the manufacture of these pistons, in the laboratory on alloys and on physical characteristics of the metal in these pistons, but I have worked with the various automotive engineers in the United States on the adaptation of these aluminum pistons to the various motors, and I have also been familiar with the general aluminum piston business, especially as carried on by the Aluminum Company of America and its associated companies.

Q. Now, just what do you mean by "its associated companies"? A. Particularly the United States Aluminum Company, which is the manufacturing subsidiary of the Aluminum Company of America, and also it may be considered that Aluminum Industries, Incorporated, of

Cincinnati, may be associated with the Aluminum Company, in a way, inasmuch as they are manufacturing pistons under the same patent, and they also make pistons according to the same design.

Mr. Bruninga: I object to the witness' statement that the pistons manufactured by the United States Aluminum Company and the Aluminum Industries are made under these patents in suit. In the first place, that is a mere expression of opinion of this witness; in the second place, the licenses should be produced.

Mr. Richey: Of course we will go into the details of the patents in suit and these pistons after I have proved the pistons up, then I will have him discuss the patents and explain how they come under the patents.

The Court: That is a question that the Court is going to decide anyway, and it is also a question you may cross examine on as to statements made. I don't see there is anything I can do about it at this time.

Mr. Bruninga: The point Mr. Richey makes is aside from my objection. My objection is that when this witness says they are made under this patent, which presumes a license, that the licenses must be produced so that this court can determine whether they are made under the patent.

Mr. Richey: Well, the licenses don't show anything about that, whether they are made under the patent or not. A man may have a license and never manufacture under it.

The Master: If he claims the manufacture is made under it, I should think the license should probably be pertinent. We will meet that question when we come to it.

Q. You may proceed with your answer. A. I also had in mind the Aluminum Manufactures, Incorporated, which was the predecessor company of United States Aluminum Company insofar as piston manufacture is concerned, and the predecessor of Aluminum Company of America insofar as piston sales is concerned.

Q. I show you two pistons, one marked for identification Plaintiffs' Exhibit 17, and the other Defendants' Exhibit AAA, and ask you to state whether or not those are made commercially? A. Yes, they are.

Q. Who makes them commercially? A. United States Aluminum Company, Bohn Aluminum & Brass Corporation, Aluminum Industries, Incorporated, and insofar as Exhibit 17 is concerned, I think the Sterling Products Corporation.

Mr. Bruninga: Do you know that of your own personal knowledge, that Sterling Products Company makes pistons like Exhibit 17?

The Witness: I never saw them being made in the Sterling plant, no.

Mr. Bruninga: I object to that.

Mr. Richey: He knows it as a man who knows the piston business. Of course in proving commercial success you can't go and get the man who saw every one of them made. You have to rely on the man with general knowledge.

The Master: He states it as his belief. You may cross examine on that.

Q. Take this Exhibit 17, how long has that been manufactured by the United States Aluminum Company or its predecessors in business? A. I think about 11 or 12 years.

Q. And how long has it been manufactured by Aluminum Industries, Inc., or its predecessors? A. This particular type of piston I can't say. To the best of my knowledge, however, it is since 1923 or '24, at any rate.

Q. And how long have pistons like Exhibit 17 been manufactured by the Bohn Aluminum & Brass Corporation? A. To the best of my knowledge about the same period as the Aluminum Industries, Incorporated.

Q. Do you know if that piston was ever manufactured by anyone who has since discontinued its manufacture? A. I can't say from my own knowledge.

Q. You don't know about Levett? A. No, I don't recall whether Levett made this particular kind of piston or not.

Q. You do know the Levett Company is no longer in business? A. Yes, they are no longer in the piston business, at any rate.

Q. Take the other Exhibit, Defendants' Exhibit AAA, how long has that been manufactured by each of these companies I asked you about, that is, the Aluminum Company, the Bohn Company and the Aluminum Industries? A. I should say approximately five years by the Aluminum Company, perhaps six years by Bohn Aluminum & Brass Corporation, and I can't say just how

long by the Aluminum Industries; for several years past, at any rate.

Q. Now, with the exception of the companies that you have named, has anyone else manufactured pistons like Exhibit 17 and Defendants' Exhibit AAA, to any substantial extent, I mean, I don't mean a fellow that may have made a few? A. No, I think not.

Q. Now, to what extent have pistons like Exhibit 17 been manufactured and sold in this country? A. To a very large extent. Pistons similar to Exhibit 17 have represented one of the two types of aluminum alloy pistons which have been sold in the greatest numbers in the last 10 or 11 years in the United States.

Q. What is the other type? A. The other type is the one similar to Defendants' Exhibit AAA, known as the Invar strut piston. These two types of pistons generally represent most of the aluminum alloy piston business for pleasure cars in the United States.

Q. And pistons have been sold for manufacture and for replacement trade, haven't they? A. Yes.

Q. Now, what car manufacturers have used them in the original equipment? A. Taking for example Exhibit 17, Maxwell, Chrysler, Ford, Oakland, Overland, Hudson, Hup, Lincoln; those are the ones that come to my mind at the moment, for Exhibit 17. For Defendants' Exhibit AAA I may mention some of the same companies, Hup, Chevrolet, Studebaker, Packard, also Hudson and also Chrysler, Pierce-Arrow, Franklin, and Auburn. That is no attempt at a complete list, but they are representative.

Q. Is that all you can think of at the present time? A. I could think of some more later, Marmon, and the smaller ones, but those names I think will account for the largest percentage.

Q. Could you answer it in the other way, could you tell us the automobile manufacturers which have not used in original equipment pistons like Plaintiffs' Exhibit 17 and Defendants' Exhibit AAA over the last 10 or 12 years? A. I think the only ones are the General Motors cars, with exception of Oakland and Chevrolet, that is, I believe Cadillac, Olds, Buick and Pontiac have not used such pistons in original equipment.

Q. Chevrolet used them for a short time only? A. Yes.

Q. And Reo hasn't used them, has he? A. No, Reo hasn't used them, that is true. Reo is using aluminum pistons but of the trunk pattern.

Q. And when did Franklin adopt a piston like Exhibit AAA, do you know, as their standard equipment? A. I believe it was around 1926.

Q. You said those pistons had been made and used in enormous quantities. Can you give us any information more definitely as to what the quantities are that have been sold and used? A. Well, I think Mr. Whitney testified to ninety million.

Q. No, not what he testified, but what you know of your own knowledge? A. Well, I know of my own knowledge that millions of these pistons have been made and sold in the United States.

Q. By these companies that you named? A. Particularly, to my own knowledge, the Aluminum Company of America, and indirectly, Bohn, and Aluminum Industries.

Q. Will you state whether or not pistons like Exhibit AAA and Plaintiffs' Exhibit 17 have been used substantially exclusively by the automobile companies which you have mentioned, with the exception of the Chevrolet? A. Yes, with a very few exceptions, one of which I think of at the moment, I think Hupmobile used the Ray-Day type of piston for a while in original equipment.

Q. That is, by "Ray-Day type" you mean Plaintiffs' Exhibit 8? A. Yes, by the Ray-Day piston I mean one like Plaintiffs' Exhibit 8.

Q. You said something about certain concerns manufacturing and selling pistons like Exhibits AAA and 17. Now, with the exception of the Sterling and the Ray-Day, do you know whether or not those concerns have paid royalties for the use of those pistons? A. Yes, they have.

Q. Do you know whether or not with the exception of the Ray-Day and the Sterling there have been any manufacturers of those pistons like Exhibits 17 and AAA which have not paid royalties for their use? A. Not that I know of, with the possible exception of a couple of small companies on the west coast.

Q. Do you know if these royalties were paid under the patents in suit? A. That is my understanding, yes.

Mr. Bruninga: Same objection.

The Master: Same ruling.

Mr. Bruninga: I want to call attention to the fact that this line of testimony is not proper at this time. The first thing for this Court to consider is whether or not either of those pistons come within

the scope of the patent in suit. Because the purpose of it is to show, evidently to show pronounced commercial success, which doesn't come into play unless patentability is in doubt, or unless even the question of infringement is in doubt. I want to make the objection at this time.

The Master: Of course the testimony is competent before the case is closed. It may be out of order.

Mr. Bruninga: I just to make the objection at this time. It is within the discretion of the Court, I realize that.

The Master: Same ruling. You may proceed.

Q. Do you know whether or not it is recognized in the trade that the pistons like Plaintiffs' Exhibit 17 and Defendants' Exhibit AAA come within the patents in suit?

Mr. Bruninga: That is objected to, your Honor, as not within the purview of this witness.

Mr. Bruninga: I further want to make the objection that it calls for hearsay. The parties should be produced.

The Master: Of course any expert, what he testifies to is a good deal of it the result of hearsay and his own knowledge combined. I think I will overrule the objection; you may have your exception.

A. Yes, the automotive trade generally is aware of the existence of these patents, and such pistons are generally regarded to come within their scope.

Q. Doctor, have you studied the patents in suit so that you understand the devices illustrated and described therein, their operation, functions and uses? A. Yes.

Q. Now, will you take up each of the patents in suit separately and explain the constructions illustrated therein, their operation and what they do, and compare the disclosures of each of the patents in suit with the disclosures of the other patents in suit and point out the variations in structures, modes of operation, and the results of those structures and operations? A. Considering first the Gulick patent 1,815,733, there is described what purports to be a piston with a new construction. This construction consists essentially of a piston head, to which webs are attached and a skirt also attached to the webs, the said webs containing also the piston pin bosses. The skirt is detached from the head proper at

the top of the skirt by a horizontal slot, and the construction is such that if the skirt is slotted vertically or longitudinally the skirt will have flexibility. The common or trunk type of piston does not possess this type of flexibility. The skirt portion of a trunk type piston may reduce in diameter in one direction, but if so, the diameter in a direction at right angles to such direction is increased. This may be referred to as a distortion of the piston skirt. The Gulick construction provides for a true or real reduction in circumference of the piston by utilizing the slot to gain flexibility. In such a piston, if the diameter is reduced by pressure in one direction, there is not a corresponding expansion in a direction 90 degrees to such direction. The patent itself refers to the piston construction as having rigidity with respect to transmitting power or pressure from the combustion chamber to the mechanical parts of the motor, and flexibility with respect to the expansion forces of the metal of the piston to avoid seizing or sticking when the piston expands. This is mentioned in the first five lines of the patent on page 1. The construction of the head separated from the skirt by a horizontal slot and the longitudinal slot, for the purpose of avoiding seizure is also described in the second paragraph, lines 6 to 12 of the patent. The rigidly supported pin bosses are referred to in lines 16 to 22, as is also the yielding characteristics of the skirt in response to cylinder wall pressure. The operation is also referred to beginning line 76, page 1, where it is stated that the piston skirt is slotted so that it may not expand an undue amount when the piston is heated. In operation this structure behaves about as follows: the piston can be fitted into the cylinder barrel with relatively small clearance when both piston and cylinder are cold; that is, at room temperature. When the motor is started the first effect is for the piston head to be heated, gradually, as the motor heats up, equilibrium temperatures are established. The piston heats up to a temperature considerably above that of the cylinder wall, especially at and near the piston head. The piston is always hotter than the cylinder wall because heat must flow from the piston to the cylinder wall and heat only flows from a hotter body to a colder body. If the piston is made of aluminum, or aluminum alloy and the cylinder is made of cast iron, the metal of the piston will expand more than twice that of the cylinder wall. This assumes a coefficient of expansion of aluminum equal to twice that of

cast iron, and the temperature of the aluminum at least somewhat greater than that of the cast iron cylinder. Even an aluminum alloy piston of the trunk type, fitted with the same clearance as cast iron, would operate a short time when the motor is started. It would not be long, however, until the expansion of the piston would be sufficient to press against the cylinder wall so tightly that the piston would stick. There would, however, be no trouble from slapping or noise with such a fit. The motor would not be useful, however, because it could only be operated a few seconds or at most a few minutes before seizure occurred. If the aluminum alloy trunk type piston is given sufficient clearance so that it will not seize when the motor is hot, it makes a slapping noise or may make a slapping noise when the motor is cold, and also there is a tendency toward oil-pumping. In the Gulick construction the piston can be fit close enough at ordinary temperatures so that no slapping occurs when the motor is cold, and the yielding characteristics of the web and skirt may be taken advantage of to prevent seizure when the motor is hot. Thus the Gulick piston can be made of aluminum alloy and fitted closely, or fitted with small clearance in the piston at ordinary temperatures and will not seize at high or motor operating temperatures. The operation is one of the flexing of the skirt in response to cylinder wall pressure as required to avoid seizure. The Gulick construction may be referred to, in part at least, as a double walled structure and although the piston as shown has splendid yielding characteristics of webs and skirt, it is nevertheless an expensive construction to manufacture.

In the Jardine patent 1,763,523, there is gained in a large measure the flexing result of Gulick but a piston is provided having but a single wall, light in construction and economical in manufacture. In the Jardine piston the webs holding the bosses may do double duty as compared with the webs shown in the Gulick construction. This is particularly shown in Figs. 6 and 7 of the Jardine patent. Here the webs holding the bosses attach to the head flange at the bottom of the ring groove portion rather than to the head direct. This permits of a single wall construction. The skirt portion around the bosses is entirely removed in the construction shown in Figs. 6 and 7. Most of the bearing of the skirt is taken on what is known as thrust faces, which are the two faces 90 degrees from the wrist pin boss axis. The Jardine

construction is therefore simpler than the Gulick construction and provides a piston of lighter weight and one which is cheaper to manufacture. The skirt segments in Figs. 6 and 7 are separated from the head by horizontal slots. There is in effect a horizontal slot completely around the piston at the bottom of the ring flange. That is true in so far as contact with the cylinder is concerned. It is not true in so far as continuity of metal is concerned in the piston construction. The skirt is attached to the head by means of webs, which webs also carry the bosses. The thrust faces of the skirt may also be slotted vertically, or one of the faces may be slotted vertically to produce flexibility and yielding in response to cylinder wall pressure.

There are several ways of combating the clearance problem in the use of aluminum alloy pistons in cast iron cylinder barrels. One is the reduction of temperature of the skirt. This is present in Gulick to an extent by virtue of the horizontal slot at the bottom of the ring flange. It is also present to an extent in the Jardine piston inasmuch as the air gap at the horizontal slots, disconnecting the bearing faces from the head portion, is a heat insulator. This air gap does not permit the heat from the head to flow directly to the skirt at the bearing faces. The skirt is therefore maintained at a somewhat lower temperature than would obtain if the head and skirt were integrally connected horizontally. There is another way to help compensate for the excess expansion of the aluminum and that is by taking advantage of such distortion of the piston as may be produced by the differences in temperature of the different parts of the piston. The Jardine construction represents an example of this. When the piston head portion is heated to a high temperature, it expands more than the cooler skirt portion. Inasmuch as it is integrally connected to the skirt portion only in the region above the bosses, this entire head expansion tends to spread or increase the diameter of the piston in a direction parallel with the wrist pin boss.

We may refer to two varieties of expansion: one as thermal expansion. This is the normal expansion of the metal as the result of being heated to a certain temperature. The other is mechanical expansion. That is the expansion due to mechanical forces, no matter what the origin.

In this particular construction, as for example shown in Figs. 6 and 7 it will be found that the expansion of a

certain portion in a direction parallel with the wrist pin, at the top of the skirt portion, is greater than that which can be accounted for by temperature alone. This excess expansion may be called mechanical expansion and is clearly understood as being the result of the excess thermal expansion of the head portion. In a trunk type piston this mechanical expansion is imparted fairly uniformly to the top of the skirt. When the top of the skirt is slotted, as shown in Figs. 6 and 7 of the Jardine patent, this excess expansion occurs in a direction parallel with the wrist pin, and there is a contraction, there is a compensating contraction in a direction perpendicular to that of the wrist pin axis. This mechanical expansion can only be taken advantage of when the skirt around the bosses is relieved, allowing space for such metal to move freely. It may be noted that there is no such relief around the bosses in the Gulick patent. So the Jardine construction differs from Gulick in that respect, and the mode of operation differs also as described. The final result is, however, pretty much the same as Gulick in operation, with the exception of the lightness and cheapness of manufacture mentioned earlier.

Q. Will you explain why it is cheaper to manufacture? A. The Jardine piston, especially the one shown in Fig. 7, is cheaper to manufacture, in the first place because it contains less metal, and it is cheaper to manufacture, in the second place, because it is a much simpler construction. A single wall is always cheaper to manufacture than the double wall; and in this particular case there is another advantage that the Jardine piston can be cast in a permanent mold, and thus a better grade of metal can be gotten into the Jardine piston than into the Gulick piston.

Q. Suppose you explain briefly what you mean by permanent molds as distinguished from sand molds. A. Well, the permanent mold is made entirely of metal, almost entirely of iron and steel, and as many as fifty thousand pistons can be made in one mold. Each piston is like every other one, so there is great uniformity in size and in weight, and the chilling effect of the mold imparts hardness and resiliency to the metal in the piston, which is very desirable in these pistons which must have flexible skirts and webs.

Now, in the sand casting process the outside of the mold is made of sand and the inside is made of sand. There is just one casting made from one mold and the mold is broken into to get the casting out, and the core

is broken up and it is shaken out of the inside of the casting. The Gulick piston might be made with an iron outside and sand inside, but in any event it would be a more expensive piston to manufacture than the Jardine piston.

Now, considering the Maynard patent, 1,655,968, this patent as shown, has a construction a good deal like that of Jardine, shown in Jardine's Figs. 6 and 7, with the exception that the bottom of the skirt forms a complete bearing in the cylinder wall. This is a distinct improvement over the Jardine construction because it embodies the horizontal slot and the relieved bosses and the vertical slot for flexibility and adds an improved guide section below the bosses which not only assists in guiding the piston in the cylinder barrel, but also assists in reducing the pumping of oil. The construction is therefore different from Jardine in that respect, namely the addition of the full bearing at the bottom of the skirt, but the mode of operation is about the same, with the exception of the oil-pumping, and the result is about the same with the exception of the better bearing and oil-pumping, both of which are improvements over Jardine. The Maynard construction, as shown in the figures, has proved to be a very satisfactory one in commercial use.

Q. Now, before you pass from that Maynard patent, will you explain why it is possible to make the skirt complete at the bottom as against the top? A. The bottom of the skirt in the first place is not as hot as the top of the skirt, so that it does not require as much clearance as the top of the skirt. Furthermore, it is easier to provide flexibility at the bottom of the skirt than it is at the top of the skirt. The top of the skirt is both difficult to make flex and it is very hot. That is, the compensation for extra expansion at the top of the skirt must be greater than at the bottom of the skirt, due to the differences in temperature. And that extra compensation at the bottom of the skirt can be taken care of by the mechanical expansion and distortion, as mentioned in connection with Jardine, which requires relief around the bosses, whereas the greater ability to flex and the lower temperature permits a bearing around 360 degrees at the bottom of the skirt.

Q. They use in the patent the term "freezing." What does that mean? A. That means the same as sticking or seizing.

Q. Over in Fig. 1, the line where the web connects the skirt is shown inclined. Will you state what if any

importance there is to inclining it to the vertical? A. It is a part of the construction to have the line, to have the bearing shorter at the top of the skirt. Taking Plaintiffs' Exhibit 17, for example, and holding it with the head up, in the head up position, the line you refer to is, I take it, the one on which my pencil is now resting (indicating).

Q. Yes. A. The need for compensation due to excess expansion is a maximum on the skirt at the very top, and if that portion could be cut away entirely, the expansion problem would be best taken care of. It cannot be cut away entirely, however, and still have the piston function as it should as a bearing against the cylinder wall. The expansion difficulties are better taken care of by making that contact small, and that is accomplished best by increasing the bearing area as one progresses down the skirt from the top. That naturally produces the angularity of the line mentioned.

Q. Shown at F in Fig. 2 of the Maynard patent?

A. Yes. Successful pistons of the Maynard type, however, have been made, sold, and used, in which the line F is vertical. A little greater initial clearance, however, is required with such a construction.

Q. You say that such pistons with that line made straight have been made, sold, and used. In what quantities and by whom? A. They have been made and sold by the Aluminum Company of America or its related companies, and they have been used by the Willys-Overland Company and the Oakland Company, merely to mention two.

Q. In what quantities? A. Considerable quantities; I can't say exactly.

Q. That is, hundreds or thousands of them? A. Oh, thousands of pistons.

Q. Now, will you proceed with the next patent?

(Short recess taken.)

A. Considering now the Mooers United States patent 1,422,800, this is a piston which has no skirt flexibility. The piston consists of a head portion and a skirt attached to the head by means of a number of connectors extending from the bottom of the flange portion of the head to the top of the skirt. In the Mooers piston there is a horizontal groove completely around the skirt at its top extending in some places entirely into the hollow structure of the inside of the piston, and in others ex-

tending merely into the metal of the connectors. It is stated that the invention contemplates the construction so that the piston can be readily made in permanent molds. By virtue of the horizontal slot, the piston skirt near the head does not become as hot as it would if the horizontal slot were absent. The reduction in skirt temperature should therefore help in reducing the amount of clearance required to prevent seizure. In the regions of the connectors, however, the heat from the head is transmitted directly to the top of the skirt, and hence these portions of the top of the skirt will become relatively hot. Relief is provided in the top portion of the skirt adjacent these connectors so as to permit the top of the skirt in these regions to expand freely. It may also be observed that the mechanical expansion will also be present in the Mooers piston, and the effect of it will be a maximum at the very point where relief is shown. This will permit the distortion of the piston at the top of the skirt to also partially compensate for the extra expansion of the aluminum. There is no relief at the bottom of the skirt portion and consequently full clearance must be provided at the bottom of the skirt. The construction is one which provides therefore, for reduction of skirt temperature and for distortion of the top of the skirt as a result of mechanical expansion, and relief at the proper places so that the mechanical expansion can be taken advantage of in the reduction of clearance. To put this a little more clearly, there is no skirt distortion until the piston has been heated. There is no need for compensation for the extra expansion until the piston has been heated, either. Thus the piston could be fit with less clearance in the cold than a trunk type piston and yet would not seize at the high temperatures. In as much, however, as this piston does not provide for flexibility of the skirt, it must be regarded as inferior to the constructions previously discussed, namely, Gulick, Jardine, and Maynard, in so far as ultimate results are concerned. It apparently in its present form cannot be fitted with sufficiently low clearance to satisfy the current demands for noiselessness. It does have, however, these important features of construction apparently necessary for the best operation.

Turning now to Schmiedeknecht patent 1,256,265, this specification refers specifically to a means of constructing a piston so as to reduce weight and yet retain rigidity and strength. It is primarily designed, accord-

ing to the specification itself, for the construction of a light weight cast iron piston. The same construction, however, or elements of construction, can be used to advantage in aluminum alloy for the purpose of gaining strength and rigidity in a light weight structure. The particular feature of the Schmiedeknecht construction which is stressed, is the web which connects with the boss near the inside and with the skirt at some distance from the boss. The skirt itself is removed around the bosses and below the bosses for some distance, so that there is an opening between the web and the bottom of the skirt, designated as 16 in Fig. 1. One of the known difficulties in connecting wrist pin bosses to a thin walled skirt is the insufficiency of the support of the boss and the weaving of the skirt portion during the operation of the piston. It was the object of the Schmiedeknecht patent to make light-walled structures and yet avoid this poor or insufficient boss support. The same construction or a similar construction has been found advantageous in the aluminum alloy piston.

Mr. Richey: I offer in evidence as Plaintiffs' Exhibit 17 the piston heretofore marked for identification as Plaintiffs' Exhibit 17, one of the commercial pistons of the plaintiffs' licensees.

Q. Will you now compare this piston, Plaintiffs' Exhibit 17, in construction, mode of operation, and results, with the pistons illustrated and described in each of the patents in suit? A. Comparing Plaintiffs' Exhibit 17 piston with the Maynard patent first, it is apparent that the piston is substantially identical to that shown in the drawings of the Maynard patent. It consists of the head portion with ring flange to which are attached two webs on opposite sides of the ring flange, the webs containing the wrist pin bosses and the webs being separated from the bottom of the skirt by openings below the bosses. It also has, in so far as contact with the cylinder is concerned, what amounts to a horizontal separation completely around the top of the skirt. It also has reduced bearing area of the skirt at the top and on the thrust faces, that is, faces at right angles to the axis of the wrist pin. It has the complete bearing for the cylinder wall at the bottom of the skirt, namely, below the bosses. The skirt bearing area is completely separated from the head by two horizontal perforations which penetrate into the hollow section of the interior of the piston. It has a so-called longitudinal slot which is even placed at a

slight angle with the vertical axis of the cylinder, or the piston, as shown in the drawings of the Maynard patent, Figs. 1 and 2. The sections of metal appear to be quite comparable to those shown in the drawings, and with my two hands I can produce visible and perceptible flexibility in the vertical slot, which shows that the piston operates the same as that shown in the Maynard patent. If properly fitted, I am certain that this piston will give the results of the Maynard patent.

Q. This piston, Exhibit 17, you mean? A. Yes.

Q. Well, you say "properly fitted." How is that piston fitted in use,—properly or improperly? A. This piston is given a small clearance in use, a clearance quite comparable with that used in the fitting of cast iron pistons of the trunk type in cast iron cylinders. Of course, any piston can be wrongly fitted in any cylinder, and under such circumstances it will not give proper results.

Q. Well, is it or is it not ordinarily fitted in the manner you speak of as being properly fitted? A. Oh, it is fitted properly. People know how to fit such pistons at the present time.

Q. Now, you said Exhibit 17 was substantially the same as the piston shown in the Maynard patent. What if any differences are there, and are those differences of any importance in operation and result? A. No, I can see no difference between Exhibit 17 and the disclosures in the drawings in the Maynard patent that would affect the operation.

Q. Or results? A. Or results.

Q. All right, now, will you proceed with the comparison of Exhibit 17 with the other patents in suit? A. In so far as the Jardine patent is concerned, this piston corresponds quite closely with the construction shown in Figs. 6 and 7 down to a point about opposite the lower portion of the bosses. It has the same head construction and the same web construction at the upper portion and the same general type of boss relief at the top of the skirt. It differs from the Jardine construction essentially in the completion of the bearing surface at the bottom of the skirt and the abbreviation of the web. The webs of the Maynard patent are made shorter, especially below the bosses. In so far as operation is concerned this piston will operate substantially the same as Jardine from the bosses upward, but it will provide a better bearing and better elimination of oil-pumping by virtue of the full bearing below the boss section. So the

result of the piston Exhibit 17 should on the whole be somewhat better than the result of the Jardine, specific Jardine construction shown in Figs. 6 and 7, although embodying the results of such Jardine piston about from the boss portion upwards. In so far as Gulick is concerned, the piston, Exhibit 17, differs in construction by being a single walled, lighter construction—a single walled construction thus producing a lighter piston than Gulick. It operates at the bottom of the skirt very much the same as Gulick. It operates at the top of the skirt differently from Gulick by virtue of the difference in construction. The top of the skirt in Gulick is quite flexible. It is sufficiently flexible to compensate for all of the extra clearance. The top of the skirt of the Maynard is not sufficiently flexible to compensate for all the difference in clearance. The other factors in Maynard are taken advantage of, such as the relief around the bosses and the mechanical distortion, enlarging the diameter across the bosses and pulling in the diameter at 90 degrees from the bosses. The compensation for the extra expansion is also partly provided for by reducing the bearing area at the top of the skirt on the thrust faces, which is not done in Gulick.

Q. Now, you have said that the Jardine piston operated differently from Gulick and the top of the skirt in Exhibit 17 operated differently from Gulick. Just what do you mean by saying they operate differently?

A. I mean that the Jardine adds to Gulick the mechanical distortion and the boss relief and the reduction of bearing area at the top of the skirt in the cylinder. That portion is a different one from the operation of the Gulick construction as shown in the diagram. It adds in fact to the flexibility of Gulick the boss relief and mechanical distortion and reduction of area of the bearing contact.

Q. That is, it employs the Gulick operation but adds to it? A. That is true.

Q. And that same thing is true of the upper part of this Exhibit 17? A. Yes, exactly.

Q. But what is meant by the difference in operation was that they all employ the same operation, but the Jardine and the Exhibit 17 add something to it? A. Yes.

Mr. Bruninga: Objected to as leading.

Mr. Richey: I am just summarizing.

The Master: I think that should be sustained. He has already answered it; so there is not anything to it.

Mr. Richey: I am just summarizing. I think I may ask a leading question when I summarize. He may answer?

The Master: It may stand. The answer as given was "Yes."

Q. Will you proceed with your comparison of Exhibit 17 with the patents in suit? A. Exhibit 17 has what might be called these short connectors between the ring flange portion of the head and the skirt, as described by Mooers, in Mooers' patent. And the construction of this Exhibit 17 near the junction between the head portion and the skirt portion is somewhat like that described by Mooers. The operation at the top of the skirt is also, in part, similar to that described by Mooers, namely, the hottest portion is that which is directly connected with the head and adjacent portions of the skirt. These portions will become hotter and hence expand more than the portions of the skirt which are insulated from the head by the air gaps. This expansion will cause mechanical distortion, which is taken care of in one direction by relief and in the other direction by reduction in clearance. So far as that element is concerned, it is present in the Exhibit 17 as well as the flexibility feature described in Gulick.

With respect to the Schmiedeknecht patent, it can be noted that the boss construction of Exhibit 17 is generally similar to that of the Schmiedeknecht patent. The web in the Schmiedeknecht drawing attaches to the skirt near the inner part of the boss and to the head portion near the outer portion of the boss to a greater extent than is found in Exhibit 17. That is shown particularly in Fig. 5. On the other hand, the openings below the bosses in the skirt are substantially the same as in the Schmiedeknecht and there is the full bearing section at the bottom of the skirt. Schmiedeknecht however has no provision for flexibility nor for clearance compensation, and it was not intended in his construction by itself, because it was intended that this particular construction as he described it would be applied to cast iron.

Q. I now call your attention to Plaintiffs' Exhibit 1, the Sterling piston, and ask you to assume, first, that this vertical slot is cut through at the bottom and top so as to make it continuous from the bottom of the skirt to the top, that is, from the bottom to the horizontal slot, and compare such a piston with the piston Plaintiffs' Ex-

hibit 17, and the patents in suit, in structure, mode of operation, and results. A. Plaintiffs' Exhibit 1 appears to be a duplicate of Exhibit 17, although made in different mold, as can be seen by the shape of the core sections.

Q. That is, Plaintiffs' Exhibit 1, assuming the slot cut through? A. Yes. They both appear to be Ford pistons for the Model A four-cylinder car, and hence what I have said with reference to Exhibit 17 may be said with the same force with respect to Plaintiffs' Exhibit 1.

Q. That is, with respect to the comparison of the two in construction, mode of operation and results, with the patents in suit? A. Yes.

Q. Which ones of these pistons, Exhibit 17 or Exhibit 1, were on the market first in order of time, I mean? I don't mean those particular pistons; I mean pistons of that type made by the plaintiffs' licensees. A. I think Exhibit 17, so far as my knowledge goes.

Q. Now, assuming that the slot was not cut through in Plaintiffs' Exhibit 1, would you compare that in structure, mode of operation and results with the disclosures in the Mooers and Schmiedeknecht patents in suit?

Mr. Bruninga: I may say they are never intended to be used that way at all; so you might just as well leave that out. I don't know of a single one that has been used without the slot cut all the way through.

Mr. Richey: Well, they were sold that way.

Mr. Bruninga: They are sold that way; but they are, as this witness may know, for the reason they are fitted to the cylinder first and then slotted; never used in an engine, never intended to be used, without that slot cut all the way through. So the question of comparison of the Mooers patent, as to whether the slot is cut through all the way or not, is utterly immaterial to this case.

Mr. Richey: You can infringe the patent by making, selling, and using. You might make an article, sell it, and never use it.

The Master: Oh, I think the testimony is competent. You may meet it if you desire.

-A. All that I have said with reference to Plaintiffs' Exhibit 17 with reference to the Mooers and Schmiedeknecht patents applies as well to Plaintiffs' Exhibit 1 if the slot is not completed.

Q. Will you compare Plaintiffs' Exhibit 8, the Ray Day piston, with the slot cut through, in structure, mode of operation, and results, with the Gulick, Jardine, and Mooers patents in suit?

(Thereupon adjournment was taken to 1:15 p.m. of the same day. Whereupon at 1:15 p.m. the hearing was resumed.) (Question read to witness.)

A. While the piston, Plaintiffs' Exhibit 8, differs in detail in construction from the specific drawing shown in the Gulick patent, it has the complete separation of the skirt from the head at the top of the skirt the same as Gulick, and the longitudinal slot in one of the thrust faces, the same as Gulick, and has the same mode of operation, and produces the same results. In so far as the construction is concerned, the webs connecting the head and the skirt have approximately the same construction as in Fig. 1, for example, of the Gulick patent, from the head to the central part of the boss. The boss in the Gulick construction is, however, completely supported by the webs and not at all supported by the skirt portion immediately adjacent the outer extremities of the bosses. In the Ray Day construction, the bosses are partly supported by the webs and partly by the skirt portion itself. The webs are made flexible, the same as in the Gulick construction. The webs are not attached to the skirt below the bosses, as described specifically in the Gulick drawings.

As mentioned at another time, the Gulick construction shows no relief around the bosses, but the Ray Day piston, Plaintiffs' Exhibit 8, does show such relief. This relief, however, is shown in the Jardine patent in combination with slots to secure flexibility. In this respect the Ray Day piston has the construction of Jardine and operates like Jardine and produces the result of Jardine. The Ray Day piston has a horizontal slot at the top of the skirt, as mentioned before, the same as the Mooers construction, and the connection between the head and the skirt is moved to the inside of the piston so that the heat flows from the piston head to the skirt through restricted areas. At these areas of connection Mooers shows relief of the piston skirt and the same type of relief is found in the Ray Day piston, Plaintiffs' Exhibit 8, adjacent the portion which would become hottest in operation of the piston, namely, in the region around the bosses; so from that standpoint, the Ray Day piston, Exhibit 8, has the construction similar to Mooers and

mode of operation in that respect similar to Mooers and results similar to Mooers.

Q. Would the part of your preceding answer which refers to the Mooers patent apply to Plaintiffs' Exhibit 91 A. Yes.

Q. Would you look at this Defendants' Exhibit AAA? You said this morning that this piston was manufactured by the licensees of the plaintiff. Is there any variation in such pistons with respect to the length of the longitudinal slot? A. Yes; the longitudinal slot may be open at both ends as well as open at one end only.

Q. And state whether or not in your opinion pistons like Exhibit AAA with these slots in the various forms you have mentioned would possess any features of any of the patents in suit? A. In my opinion the piston AAA does embody a number of the features of the patents in suit. In addition to the other elements I have mentioned, this piston has in it what is known as an Invar steel strut. This particular piston contains two struts: one above either boss, and the struts are roughly perpendicular to the axis of the wrist pin. These struts are cast into the aluminum at the time of manufacture and by virtue of their low co-efficients of thermal expansion, exert a powerful restraint against the expansion of the aluminum when the piston is heated. The piston is also provided with a horizontal slot at the top of the skirt which separates the head from the skirt with an air gap, thereby permitting the piston to operate at a lower temperature than would obtain if the skirt were connected to the head around the periphery. The skirt is also relieved around the boss. In some cases the restraining effect of the Invar strut is so powerful, at least in conjunction with the means to keep the temperature low and the relief of the skirt, to compensate for the excessive expansion of aluminum at the top of the skirt. In such cases it is desirable to provide for some means of flexing at the bottom of the skirt. There are also some involved changes in the piston itself due to the forces set up as a result of the unequal expansions of the steel parts and aluminum parts, which perhaps need not be further mentioned here.

The commercial history, however, of this type of piston proved that some means of flexing was essential for success. Strenuous efforts were made to produce a satisfactory strut piston which would have no flexing means. So far as I am aware these efforts all failed and the com-

mercial strut pistons today all use some means of flexing either the entire skirt or the bottom portion of the skirt.

Q. What mileage in automobiles is realized by these pistons like Exhibit 17 and Exhibit 1 with the slit through and Defendants' Exhibit AAA?

Mr. Bruninga: Objected to unless this witness has knowledge of it.

Mr. Richey: Well, he has qualified himself upon that.

Mr. Bruninga: I would like to have him state that he has knowledge of that.

A. Yes, I have knowledge of the life of this type of piston, both the Invar strut type and the so-called all-aluminum type. I have personally operated a set of the Invar strut type more than thirty thousand miles and I have observed tests on the block in the laboratory running up to forty or fifty thousand miles of the all-aluminum type. I know from my contact with the automotive industry and with the aluminum piston business that these pistons will run up to fifty thousand miles or more, if the car is properly taken care of.

Mr. Richey: Now, yesterday, Mr. Bruninga offered in evidence this Exhibit BBB during our prima facie proof. I don't know what the purpose of his offer was. What was your purpose in offering this BBB in evidence?

Mr. Bruninga: Well, that is being made, I mean that is being sold by the particular defendants in this case, and there was no objection made, and I would like to ask you right now if you consider that as an infringement.

Mr. Richey: That is what I was coming to. When we answer that, we would like to answer it completely; therefore we have to take this and consider it carefully in connection with the patents, because I have no doubt you will want us to declare on the claims, too.

Mr. Bruninga: Yes.

Mr. Richey: And we are not prepared to do that at the present time; so I would like to recall Dr. Jeffries when we are prepared to do that, which I think we will be before we get out of our prima facie case.

Mr. Bruninga: That is perfectly satisfactory.

Mr. Richey: Of course this Exhibit OCC,—he didn't say he sold that piston.

Mr. Bruninga: He didn't say that. Now, in connection with Exhibit AAA, that was simply produced and identified and offered in evidence to show what the particular defendant was selling. I don't know whether I asked him where he obtained it.

Mr. Richey: You don't mean defendant.

Mr. Bruninga: One of the defendants was selling. I don't know whether I asked him whether he obtained that from a licensee. I couldn't anyway, because we didn't know who the licensees are.

Mr. Richey: We will concede he bought it from one of the licensees of the plaintiff.

Mr. Bruninga: I just want to have before the court the piston that this man was selling.

Mr. Richey: I have one more matter with this witness. I would like to have a recess for a few minutes until Mr. Burton comes here. In the meantime we have the reports Mr. Whitney talked about yesterday.

(Short recess taken.)

Mr. Richey: We have produced these royalty reports that Mr. Whitney testified about. Mr. Bruninga said he thought it would only be necessary to produce specimens of them. They are picking them out now. I can go ahead with the witness.

Mr. Bruninga: I can pick them out later.

Thereupon ZAY JEFFRIES resumed the stand.

By Mr. Richey:

Q. Doctor, you have gone over these royalty reports Mr. Whitney testified about yesterday? A. I have looked over some of them, yes.

Q. Are there code numbers on those reports? A. Yes.

Q. What do those numbers refer to? A. Blue prints.

Q. What do those blueprints illustrate? A. In so far as the Aluminum Company of America records are concerned they refer to the prints of piston drawings.

Q. What kind of pistons are shown in those drawings as compared with the exhibits here? A. I took off a number of specific blue-print numbers from the reports, not knowing what they were, but representing hundreds of thousands of pistons. Each one of them proved to

be a piston with some kind of provision for flexible skirt, all mostly pistons like Plaintiffs' Exhibits 1 and 17.

Q. You mean 17 and Defendants' Exhibit AAA? A. I mean 1 and 17 being alike; most of them proved to be that.

Q. Wait a minute. 1 is this defendants' piston without the slit completed. Did you mean to refer to that? A. Oh, they are like Plaintiffs' Exhibit 17, because they call for the completion of the slots.

Q. And these reports were from what companies? A. This is the Aluminum Company of America.

Q. And there were reports there from others? A. Oh, yes, there were reports from Bohn Aluminum & Brass Corporation, and Aluminum Industries, I think some earlier reports, too, from Levett.

Q. Are you familiar with the pistons made by these people covered by these reports? A. Yes, in a general way.

Q. You didn't check the code numbers on those? A. No.

Q. Well, state in a general way. A. They are similar to the pistons made by Aluminum Company of America.

Q. And when you say "similar" just what do you mean? A. I mean they are made for the same cars, with the same general construction, and the same mode of operation.

Q. The same in substance? A. Yes.

Mr. Richey: Now, we produce those reports for our adversaries to use in cross examination if he wants to, either specimens or all the reports. I don't think there is any use of putting them in evidence, but we didn't want to take them away from the plaintiff. I don't think they are competent; and we have also produced the licenses here. I feel, as I said yesterday, that they are incompetent and just increase the bulk of the record. The only thing competent on the question of commercial success and public acquiescence is the fact that there have been licenses granted, royalties paid, and large numbers sold, and the licenses don't have anything to do with that.

CROSS EXAMINATION OF MR. JEFFRIES by Mr. Bruninga.

Q. Dr. Jeffries, how much practical experience have you had in the actual manufacture of pistons, particularly aluminum pistons? A. Well, I have spent most of the summer of 1916 in the actual manufacturing operations of aluminum alloy pistons, even going so far as to operate molds. And then I have spent a considerable amount of time in the piston plant, working on piston problems of one kind or another, mostly when troubles came up.

Q. Your experience in the summer of 1916 was with the regular trunk piston, unslotted and unrelieved, and so forth? A. Yes.

Q. You never had any experience in the actual fitting of pistons to a cylinder? A. No, not to do it with my own hands.

Q. So far as the split pistons are concerned, your experience has been a matter of observation and watching what others do and drawing your own conclusion; is that right? A. Well, yes, and also getting the conclusions of others and examining pistons after they have come out of motors to see what the results of tests were and things of that sort.

Q. You have never been an engineer in an automobile manufacturing plant? A. No.

Q. You never have had the job of designing any pistons for actual use in automobile engines? A. No.

Q. Never had any experience in actually making them? A. You mean machining them?

Q. Machining them? A. No.

Q. And you have never had any experience in actually fitting them? A. No, not with my own hands.

Q. Now, you referred to the Langmuir patent case in which you were an expert. That was a suit between DeForest Company and General Electric, was it? A. Well, no, I had in mind the one between General Electric and P. R. Mallory Company on gas filled lamps. The one with DeForest was on radio tubes, it wasn't a gas filled lamp patent. However I did give testimony in one of the other suits. No, it wasn't the Langmuir suit with the Radio Corporation.

Q. Now, the Aluminum Company of America suit that you say you have testified in, included the Kant-Skore case in Cincinnati in 1923; is that right? A. Yes.

Q. And the Sterling case in St. Louis, tried in March, 1931? A. Was it '31 or was it earlier? It was the Sterling case in St. Louis, at any rate.

Q. And that included the suit against United Engine & Machine Company in San Francisco last October, just a few months ago? A. Yes.

Q. And all those suits were on the so-called molding patents of Aluminum Company of America? A. Yes, molds, processes and articles.

Q. And I represented the United Engine & Machine Company in that suit in San Francisco, didn't I? A. Yes, as far as I know; you were there and tried the case.

Mr. Richey: We agree that you represented them. One of the lawyers.

Q. You used Exhibit 14 or one substantially identical with it in both the Sterling and United cases, didn't you? A. Yes, one showing the same type of section, at any rate.

Q. In the Sterling case Judge Farris held the process and product patents invalid and the other mold patents not infringed? Held the process and product patents invalid and the mold patent not infringed; isn't that it? A. Yes.

Q. That was about a year ago last September? A. I don't remember; about that time, yes.

Q. Now, in the Kant-Skore, Sterling and United cases you took the position that the things that made the aluminum piston a success were the process, product and molding patents involved in those suits; isn't that right? A. That is correct.

Q. And that the success of the aluminum piston really dated from the time that those so-called inventions appeared? A. That is correct.

Q. You did not stress the importance of these patents in suit, did you, in any of those cases? A. Yes.

Q. You did stress the importance of them? A. Yes. It was particularly brought out that the slotting of the skirt was current practice, both by yourself, Mr. Richey, and myself; and the importance of the great resiliency and hardness and strength of the metal in the permanent mold castings was stressed as having a very important bearing on the success of the slotted skirt piston.

Q. But you emphasized the fact that the production of those pistons under chilling conditions enabled the slotted structure to be used; isn't that right? A. Yes, practically.

Q. That was just about your position? A. That is practically the case. That is the history of it, too.

Q. And you emphasized the fact that before the advent of the slotted skirt from seven million to ten million pistons had been produced that were never slotted? A. That is correct.

Q. You also emphasized the fact that even at that time, that is, last October, the Reo Company still used non-slotted pistons? A. That is correct.

Q. Now, were you familiar with the aluminum piston business before December, 1915? A. No.

Q. You weren't familiar with pistons at all? A. No.

Q. The piston in use at that time was the trunk piston? A. The trunk aluminum piston? The trunk aluminum piston and the trunk iron piston, yes, those were the two pistons that were used at that time.

Q. And that piston was substantially the construction shown in Exhibit 14? A. Yes. Some of them had no wiping ring at the bottom. I might indicate by letter I (witness places letter on Exhibit 14). The first aluminum alloy piston that I knew about did not have this wiping ring at the bottom.

Q. But they had wrist pin bosses projecting inwardly from the sides of the skirt? A. Yes.

Q. Both iron and aluminum? A. Yes.

Q. And they had webs going across the piston head and going down to the skirt? A. Well, we call those ribs, but they have strengthening projections in the inside, at least some of them did.

Q. And both aluminum and iron pistons were relieved in the regions opposite the wrist pin bosses, on the outside? A. I think not. At least I don't recall that they were. We had one type of piston known as the hour-glass piston which did have relief all the way around the skirt. That certainly was relieved at the bosses but it was relieved in other parts of the skirt as well.

Q. But not relieved by an actual dishing in, for instance as in Defendants' Exhibit BBB? A. No, not that I recall.

Q. It was the practice at that time to make the head considerably smaller than the skirt? A. Yes, in the machining operation.

Q. Do you remember whether that was standard practice? A. Yes, that was standard practice.

Q. There was a certain standard decrease in diameter, isn't that right? A. I don't know whether it was

standard, but it was always—the head was always made smaller.

Q. It was also the practice to make the skirt of smaller diameter at the top than at the bottom? A. No, that wasn't the common practice. That is known as taper machining or taper grinding and was resorted to at times but it entails a more difficult and more costly machining operation than the cylindrical machining; so that was not resorted to commonly, as I recall it.

Q. These piston rings on such pistons were split so as to expand and contract? A. Yes.

Q. Now, taking a rib piston of that kind, in which the rib extends across the piston head, upon heating up of the piston the piston expands along the line of the wrist pin bosses, doesn't it; that is the greatest expansion, isn't it? A. In a trunk type piston?

Q. In a trunk type piston. A. Well, that depends entirely on the construction, on the disposition of metal in the piston itself. Expansion is fairly even in a trunk type piston in the different directions.

Q. Well, you have seen pistons relieved in the region of the wrist pin bosses on the outside, for instance, as in Exhibit BBB, not exactly but generally dished in, relieved area? A. Yes.

Q. You have seen ordinary trunk pistons made that way? A. Yes, I have.

Q. Why is that done in the ordinary trunk piston, un-split, whether of cast iron or aluminum? A. Well, it is done for different reasons, depending on the construction of the piston. Now, as I understand it, it is done in the trunk type cast iron piston largely because of the weaving effect of the wrist pin stresses on the skirt adjacent to the boss connection. It is desirable to relieve around those bosses to minimize the effect of this mechanical weaving. In certain of the pistons which I have considered on my direct testimony, it is done for the purpose of allowing space for metal to expand due to thermal and mechanical expansion.

Q. Where you have wrist pin bosses on the side of any trunk piston, isn't there a greater tendency to expand in that direction, that is, along the line of the wrist pin bosses? A. I don't see why there should be unless there is some special construction of the piston that makes that portion get hotter.

Q. But that does take place if you have ribs extending from the side walls and up to the top of the head, as

in Exhibit 14, along the line of the wrist pin bosses?

A. It may, yes.

Q. Well, don't you think it does? A. Well, it possibly does.

Q. What is your opinion, is there any possibility about it? It is a fact, isn't it? A. Well, I think it may be either way. That is the boss section may be better or some other section may be better, according to the piston construction. I think if you show me a piston I may be able to tell you on that particular one whether the boss section should be better or whether the other section should be better.

Q. Now, what is the purpose of the piston rings in any kind of a piston? **A.** To serve as a seal against the gases passing by the piston into the chamber below, and also to serve as a seal against the passage of oil from the lower portions up into the combustion chamber.

Q. Does the skirt of a regular trunk piston such as shown in Exhibit 14, even without the rings, perform that function? A. Just the skirt?

Q. Yes. A. In part only.

Q. The minute you split it it performs it less efficiently, isn't that right? **A.** That depends on the force required to produce the flexing of the piston skirt. In fact, it may provide that function more efficiently before having been slotted.

Q. You had in mind a vertical slot, didn't you? A: Yes.

Q. That is what I had in mind. Now, suppose we take a horizontal slot across the piston skirt, say below the ring lands, don't the skirt then perform the function of cooling? A. To an extent, yes, but still it is not sufficient.

Q. Do I understand you want the Court to understand that if you cut a hole, a slot, in a trunk piston so that the gases can get past the piston rings and out through this slot, or that there is a communication between the interior of the skirt and that slot, that still that skirt performs a sealing function? A. Oh, not against the downward flow of the gases.

Q. Does it perform any function as to any flow of the gases? A. Not as to the gas flow.

Q. What does it seal, then? A. Well, it helps, it may assist with the oil pumping, that is, it permits a close fitting of the skirt at all temperatures, when the motor is cold and when the motor is hot.

Q. Well, all the world the skirt does as far as preventing the oil pumping is to wipe that oil up and down on the cylinder, is that right? A. Yes.

Q. In the piston such as Exhibit 17 or Exhibit 1, that skirt does not perform any sealing function whatsoever, does it? A. Not against gases. It gives a better bearing, of course the skirt is a better bearing at the bottom than it would be if the skirt weren't there.

Q. It simply performs a better oil distributing function, isn't that right? A. Yes, it does that. It also helps with the guiding of the piston in the cylinder barrel.

Q. And you immediately lose that in the Jardine patent piston when you take off the circumferential part just below the wrist pin bosses? A. Yes, that function is lost.

Q. That function is lost in every slipper type piston, isn't that right? A. Yes, I think so.

Q. The Jardine patent is a distinct slipper type piston, isn't it? A. The drawing shows slipper type, yes.

Q. Well, is there any statement in the specification distinctly saying that the parts can be extended around below the wrist pin bosses? A. No, I think not.

Q. What did you gather that from, the claim? A. Well, I don't know what the latitude of the disclosure might be, no.

Q. Now, the coefficient of expansion of aluminum you said is twice as great as that of cast iron? A. Yes.

Q. Approximately so. There is no practical trouble in a cast iron piston so far as taking care of expansion is concerned? A. It was not in the early days. It is not a problem like it is in the aluminum alloy piston. There is trouble with expansion, of course. That is, if a cast iron piston is not fitted properly, why, it does not function properly then, but when the cast iron piston or the cylinder wears there is trouble due to expansion. But, broadly speaking, the problem which is met with the aluminum piston running in the cast iron cylinder, as the result of high expansion of aluminum, is not a problem in cast iron.

Q. And the aluminum piston did not come into use until about 1915, according to your views? A. Yes.

Q. At least their use was so small it could hardly be counted? A. Yes, I know of no use prior to 1915.

Q. Now, where you use a cast iron piston, then your coefficient of expansion of your cylinder and the piston are the same? A. Yes.

Q. But as soon as you use an aluminum piston, then you have got the inside expanding at a greater rate than the outside, from a pure standpoint of coefficient of expansion? A. Yes.

Q. The piston rings, however, took care of that by splitting of them, is that right? A. You mean the piston rings provide the seal?

Q. Yes, provide the seal and they also, as the piston expanded, or even as the rings expanded, the expansion was compensated for by the split? A. Well, it was in the ring groove section, yes.

Q. Rings are still made of cast iron, even in aluminum pistons? A. Yes.

Q. In other words, in the ring you have an expansion joint between the ends of the ring? A. Yes.

Q. And that is what you really have in your skirt in these pistons, isn't that right, Doctor Jeffries? A. As one element, perhaps, of the skirt.

Q. But the seal provides an expansion joint in the skirt? A. It provides space for the flexing of the skirt, yes.

Q. Isn't that what is known as an expansion joint? A. Oh, I don't know that it could be so broadly defined. You have expansion joints by large curves, as in a pipe line, or something of that sort.

Q. You have the expansion joints of that kind, that is the space between the abutting ends or rails, haven't you? A. I don't know if it makes a lot of difference what it is called, I never heard it called an expansion joint before.

Q. Now, taking up the Mooers patent 1,402,309, that is a trunk piston, isn't it? A. It is not a typical trunk piston, but its skirt is a slotted trunk, as opposed to a flexible skirt type piston. It has, however, a horizontal separation between the head and the skirt which is not associated with the trunk type piston.

Q. Well, you take out the horizontal—you take out the slot running around the piston, and separating, or partially separating the head from the skirt, and you have a trunk piston, haven't you? A. A form of trunk piston but not a Mooers piston.

Q. The distinction then is that taking out that slot you have the connectors, 3? A. That is one distinction.

Q. And those are really ribs on the inside of the piston, aren't they? A. Possibly a rib or post. They are specifically called connectors here.

Q. You have read the specification of the Mooers patent very carefully? A. Well, I have read it.

Q. What was really the purpose of the Mooers patent, what did he specifically want to do as distinguished from what preceded him; in other words, what would you say he wants to do? A. He said he would like to make a piston that is light weight and toward that end he would like to utilize aluminum. He would like to make it simple enough in construction so that it could be manufactured in permanent molds. Then he would like to give it some kind of construction which would minimize the effect of the high expansion of aluminum alloy.

Q. When he said "simpler," simpler than what? A. Simpler than a previous construction he referred to as the Spillman & Mooers construction.

Q. Do you know what that construction was? A. Yes.

Q. He refers to that three times in his patent, doesn't he? A. I assume so, if you say so.

Q. And he says, "My present invention comprises improvement on the joint invention of myself and Edward O. Spillman disclosed in letters patent of the United States 1,092,870," and after another paragraph he says he further contemplates the idea of distributing the heat from the head of the piston more effectively than in the case of the construction illustrated in the patent 1,092,870; is that a fact? A. According to what he means by "effectively." The Spillman & Mooers patent, as I recall it, shows no boss relief, no skirt relief, at any place, whereas Mooers does show rather a generous relief in the skirt at points opposite these connectors where the expansion would be the greatest.

Q. Well, the Spillman & Mooers structure didn't require it, did it, Doctor Jeffries? A. That is correct, it should at least have heated quite uniformly throughout the circumference of the skirt on any cross section.

Q. This paper that I hand you is a copy of that Spillman & Mooers patent, isn't it? A. Yes.

Q. I hand you a cross section of casting. Will you state whether that is generally a fair representation of that Spillman & Mooers patent structure, looking at it just as a model?

Mr. Richey: I think I will object to that question. You haven't any right to go into the prior art at this time. I presume you might ask him about the patent itself, but when you go beyond that it

seems to me you are exceeding the direct examination in going into the prior art in our prima facie case, which you have no right to do.

The Master: This witness has testified to this Mooers patent. This Mooers patent refers to this previous patent. I think it is competent. The objection will be overruled and you may have an exception.

Q. I don't want to tie you down to any details. I thought it would be easier for the Court to look at a cross section than a drawing. You can later on, in rebuttal, if you want to, show any differences in dimensions. I just want to use it as a model. A. I think the section you have handed me is a fair duplication of the Spillman & Mooers construction.

Q. Now, in distinguishing the Mooers patent 1,402,309 from the Spillman & Mooers patent structure, 1,092,870, the prior patent has a connection direct from the head to the bottom of the skirt, isn't that right? A. Yes.

Q. And in the Mooers patent in suit the connection is between the top of the skirt and head itself? A. It is between the top of the skirt and the head itself, or between the top of the skirt and the ring flange, just as one may wish to interpret it. The boss construction shown in the Mooers patent goes down to the head.

Q. Is it your opinion that the flow of the heat, rather the efficiency of heat disposition of the Mooers patent structure 1,402,309, is more efficient than that of the prior patent mentioned by him? A. Oh, I think if you would take the question of the heat flow itself you will find that the Spillman & Mooers construction would probably take care of it somewhat better than the Mooers construction. However, that is only one element of efficiency of taking care of heat.

Q. The efficiency of heat transmission is due to the fact that the hottest part of the piston is connected with the coldest part of the skirt, isn't that right? A. Well, that is only one element. The heat has to travel a long ways in the Spillman and Mooers to get to the skirt, and it has a considerable cross section of metal through which to travel. In the Mooers patent it has to travel a shorter distance to get from the head to the skirt, but the section of metal through which it has to travel is considerably reduced. So those two factors oppose each other.

Q. In an ordinary trunk piston the upper part of the piston is the hottest and the bottom of the skirt is the coldest, and therefore you have a gradual expansion, being a minimum at the bottom and a maximum at the top of the skirt, in an ordinary trunk piston that is not isolated? A. That is correct.

Q. And that is also generally true if you have the head and the skirt isolated to an extent as you have in the Mooers patent 1,402,309? A. Yes.

Q. And that would bring out, or that brings out in the Mooers patent an unequal distortion of the entire skirt? A. Yes, especially at the top of the skirt.

Q. And in the Spillman & Mooers patent structure, however, you get practically a uniform application of the heat from the head to the skirt itself, circumferentially? A. Insofar as the conduction through the piston is concerned, yes.

Q. You would expect, then, a more uniform expansion of the skirt in the Spillman & Mooers patent structure, is that right? A. Yes, that is correct.

Q. Now, in the Mooers patent structure, if you omit the webs, I mean omit the connectors, 3, at right-angles to the wrist pin bosses, then all of the heat must flow right through the wrist pin bosses, isn't that right, unless those connectors are displaced circumferentially with respect to the wrist pin bosses, as for instance in some of the other views? A. As I understand it, you mean to eliminate from Fig. 1 of the Mooers patent the two connectors on the thrust faces?

Q. The two connectors on the thrust faces. A. What you say then, is correct.

Q. Now, in the Spillman & Mooers patent you have actually a shunting of the flow of heat on each side of the wrist pin bosses, haven't you? A. Yes.

Q. There is also a large radiating surface in the Spillman & Mooers patent structure? A. Yes, the same thing that makes the piston heavy and complicated, double-walled, gives it more surface to dissipate heat.

Q. That is also true of the Gulick patent structure? A. That is true of the Gulick patent structure.

Q. Do you know from your own knowledge whether the Spillman & Mooers piston structure has ever gone into use? A. No. If it has, it has been very limited application. The Spillman & Mooers patent doesn't even set out, as I view it, to produce a light weight piston, and there is nothing in the patent, as I read it, mentioning

aluminum alloy, so I believe that is a thing which Mooers did set out to do. He set out to get a light weight piston which these people did not.

Q. Do you know whether the Gulick patent mentions aluminum alloy? A. No, I think it does not.

Q. The Spillman & Mooers patent application was filed on July 18, 1913, and the patent was issued on April 14, 1914. That was prior to the time that aluminum piston came into use? A. Yes.

Q. That is what you contended in the other cases? A. That is it.

Q. It wasn't until this molding process was perfected that aluminum pistons were capable of being used commercially? A. That is correct. Or, at least, they weren't used commercially. If they were capable of it or not, I couldn't say.

Q. Do you know whether there is any structure like the Spillman & Mooers structure on the market today in aluminum, that is the idea of connecting the head proper with the bottom of the skirt? A. Not that I know of.

Q. You were in San Francisco during the trial of that case? A. Yes.

Q. Do you know whether the United Engine & Machine Company marketed a piston of that character? A. No, I don't know.

Q. You have never seen a piston of that character? A. Well, I recall a piston that was brought into the courtroom as a sample that may have had some such construction, but I don't recall the details of its construction well enough to compare it with the Spillman & Mooers, nor do I know that it is on the market.

Q. What companies on the west coast did you have in mind when you said some companies were using the patented structure of the patents in suit without authorization? A. Well, I had in mind United Engine & Machine Company, and another one in Los Angeles, I don't recall the name.

Q. Jens? A. No, that doesn't sound like it.

Q. Well, how do you know that the United Engine & Machine Company are making pistons in violation of these patents in suit? A. Well, the piston I saw.

Q. You have seen United pistons then? A. Yes.

Q. Sold under the name of Silvolite? A. Yes.

Q. They aren't of the construction then of the Spillman & Mooers patent? A. No.

Q. Can you tell me generally the construction? A. Well, they are more the flexible skirt type of piston.

Q. Can you produce such a piston? A. No, I have none.

Q. You cannot even—can you give the Court some information, since you have made the statement that that company is manufacturing and selling pistons in violation of the patent? A. Not right now. I think I could in due course produce a drawing of such piston, maybe one of the pistons.

Q. Will you try to get me one by tomorrow, if possible? A. Yes, I will.

Q. Now, you happen to know that the Cleveland Trust Company was the owner of that Spillman & Mooers patent prior to its expiration? A. That is my understanding, yes.

Q. Well, don't you know? A. Well, that is I know it in the same way that I know that the Cleveland Trust Company is the owner of these patents in suit.

Q. Just what somebody has told you? A. Practically so. A little more than that. I have sat in a number of conferences and discussions before this trust was formed, and I have lived with this situation 10 or 12 years, so in that way I feel I know a few things about these matters that I may not have gotten from the particular records which bear the proper signatures, and so forth.

Q. Well, your knowledge and information on the ownership of the patents in suit by Cleveland Trust Company is no better than your knowledge or information as to the ownership by the Cleveland Trust Company of the Spillman & Mooers patent? A. No better, no.

Q. You were consulted with reference to the Simmons case in this circuit, weren't you? A. Well, I conferred with the attorneys prior to the date of the trial of the Simmons case, yes.

Q. And you know that that particular patent was one of the patents in suit in that Simmons case? A. I believe it was.

Q. The Spillman & Mooers patent. A. I believe it was, at least at an earlier stage of the case.

Q. You also know that the accused device in that Simmons case was the same as Exhibit 1? A. I don't know.

Mr. Bruninga: Will counsel agree to that or will I have to produce the record?

Mr. Richey: I think that is right, certainly I don't believe there are any differences, of any material importance between the two.

Q. Do you consider that permanent molding of the Spillman & Mooers patent structure is possible? A. Not the inside of the piston.

Q. But the outside is? A. Yes, the outside could be cast permanent.

Q. And that would produce a suitable piston, even with a semi-permanent molding process? A. So far as the outer bearing surfaces are concerned, it would.

Q. Well, you took the position in the Sterling and United cases that so-called semi-permanent molding with the metal mold on the outside and with the sand core on the inside came within the reasonable scope of the patent? A. Did I?

Q. Do you remember it, Dr. Jeffries? A. Yes, I remember it.

Q. Do you remember that you did? A. No, I don't remember that I did. I remember that I said that the same permanent mold process was capable of producing a structure with a sufficient degree of chill for the metal to act as a bearing against the cylinder walls.

Q. Then except for the matter of ease of casting, the Spillman & Mooers patented structure would be entirely feasible as a piston? A. Well, it would be feasible; it would be heavy; it does possess the structure which keeps the skirt about as cool as any structure of which I have knowledge, and it also produces a skirt structure which is very free from distortion, either thermal or mechanical.

Q. You know, don't you, that the Cleveland Trust Company prior to the date of the expiration of the Spillman & Mooers patent on April 14, 1931, collected royalties under that patent, as well as some of the other patents? A. I think they included that in the group of patents under which royalties were collected.

Q. And those royalties were collected on all the pistons that you have testified about as being licensed? A. Yes.

Q. Now, isn't it a fact that the Mooers patent structure is a compromise between efficient transmission of heat and ease in securing molding? A. Yes, and also in lightness.

Q. What Mooers really did was to leave the exterior structure of the piston substantially the same as in the previous Spillman & Mooers patent and modify the interior structure so as to enable the casting to be readily made? A. He did more than that. He provided the

means on the outside of the piston to compensate for the added temperature expansion or thermal expansion and the added mechanical expansion at the top of the skirt.

Q. Such a relief wasn't necessary in the Spillman & Mooers patent structure? A. It was not, if sufficient clearance were provided.

Q. Such relief was quite common, wasn't it, in 1917? A. Not that I know of.

Q. Well, it was known to you, wasn't it? A. I believe not.

Q. You didn't, as early as 1917, see any pistons which were relieved, aluminum pistons or otherwise, in the regions opposite the wrist pin bosses? A. Well, if I did I didn't associate it with the functions described by Mooers.

Q. Dr. Jeffries, if you took any piston, no matter what date it was, any trunk piston, whether 1915, or 1915 or 1931, and you put it in a cylinder of an automobile engine, of a gas engine, and subjected it to heat, that piston expands, doesn't it? A. Yes.

Q. And that expansion has to be taken care of? A. I don't say it has to be. It will be if it can be.

Q. And as a matter of fact you will find the wear, when you take the piston out, opposite the wrist pin bosses, will you not? A. Sometimes. Sometimes you find it all around; sometimes you find it on the thrust faces.

Q. And what is the practice of a mechanic, if he finds one part fitting in another wearing in certain spots?

A. He may have a good many practices. He may try to improve his oiling. He may try to change the dimensions. He may try to change the structure of the part that is bearing on the other part.

Q. But he wouldn't use a file to file down those places where wear takes place, is that your idea? A. Well, he might and he might not. But if he used a file he might not have a very good bearing surface when he got through.

Q. But you do know that is the practice today to provide for reliefs opposite the wrist pin bosses? A. Yes, I know that is the practice today.

Q. In the Mooers patent structure the connectors of the Spillman & Mooers patent structure are moved outwardly until they become one with the walls; is that right? A. I don't exactly know why you should say they are the connectors of Spillman & Mooers. The con-

nectors are integral with the wall in the Mooers construction.

The Master: At this time we will recess until tomorrow morning.

(Cut in half piston section offered for identification as Defendants' Exhibit EEE.)

(Thereupon at 9:30 a. m., Friday, January 20, 1933, the hearing was resumed; counsel present being Messrs. Bruninga, Richey and McCoy.)

Mr. Richey: Before we start this morning I wish to make a statement about this Exhibit BBB. Plaintiffs think that the piston Defendants' Exhibit BBB infringes the following claims already declared upon: Gulick patent claims 1, 13, 15, 18, 22, 27, 28, 29, 30, 33, 35, 36, 37, 38, 41, 42, and 43.

The Jardine patent claims 1, 8 and 10.

The Maynard patent claim 6.

The Mooers patent claims 1, 2, 3, 4, 6, 10, and 11.

Without prejudice to any right to bring suit against any one now a defendant or any time held to be a defendant in this suit upon other patents that may be now or in the future owned by the plaintiff, the plaintiff charges infringement in the instant case of the claims above announced by the piston Defendants' Exhibit BBB.

Mr. Bruninga: But you are not including the Schmiedeknecht patent?

Mr. Richey: No, we don't charge that device there infringes any claims of the Schmiedeknecht patent.

Mr. Bruninga: And if I understood you correctly, but one of the claims of the Maynard patent is infringed by this particular piston?

Mr. Richey: That is our position; that is our contention.

FURTHER CROSS EXAMINATION OF MR. JEFFRIES by Mr. Bruninga.

Q. Dr. Jeffries, I want to be sure that the court understands the procedure of permanent molding because it enters into this Mooers patent. Now, check me up if I am not correct on this, and I will briefly summarize rather than have you do it. In the permanent molding of the pistons, of such pistons as Exhibit 1, a pair of outside

mold parts, shaped to correspond to the outside of the piston, are used, and then for the inside there is a core made up of parts, in this particular case a center core piece which can be seen by the markings on the inside, and a couple of side core pieces, the three core pieces being shaped to the interior of the piston. And then a suitable gate is provided so that the metal can be poured into the mold, and the center core part is withdrawn, then the two side core parts are moved in to disengage them from the interior of the piston. That is generally the procedure, isn't it? A. Yes.

The Master: As I understand, the permanent mold is something that can be withdrawn and leave the form of the thing that is being molded without disturbing it, isn't it?

Mr. Bruninga: Well, I want to ask this witness what is meant by permanent molding. Permanent molding as applied to molding with metal as distinguished from molding with sand.

The Witness: Generally speaking, I think there are other types of material used in permanent molds, but a permanent mold, as his Honor said, is one that can be used over and over again to make the same type of casting.

The Master: That is the point I wanted to make clear.

Mr. Bruninga: But the point I wanted to make clear is the interior configuration of the core, in order to throw some light on the witness' position that the Spillman & Mooers piston is difficult if not impossible to make with a metal core.

Q. You would say the Spillman & Mooers structure will be impossible to make with the permanent or metal inside core? A. So far as the present art is concerned, that is true.

Q. But the mere fact that an interior structure is complicated does not mean that it cannot be made in the permanent mold? A. Not always. The internal structure may be so designed that it can be cast in the permanent mold.

Q. For instance, you know that the piston that I am handing you is made in the permanent mold and with the permanent core?

Mr. Richey: I object to that; nothing he was asked about in his direct examination.

Mr. Bruninga: I don't intend to use it as prior art; I just intend to use it for illustration at this point.

A. Yes; that piston was made in a permanent mold.

Mr. Bruninga: The piston is marked for identification as Defendants' Exhibit FFF.

Q. It is your contention that the Ray Day piston structure, that is, the one of the Exhibits 8 and 9, cannot be made with the permanent core? A. Yes; that piston to the best of my knowledge at the present time could not be made in a permanent core.

Q. But still, according to your position it still incorporates some of the features, at least, of the Mooers patent 1,402,309? A. Yes.

Q. So that the question of whether the Spillman & Mooers structure can not be made in the permanent mold and the Mooers patent structure can be made with the permanent mold, is not determinative at all as to what the patent structure is? A. Well, it may not be absolutely controlling; it is important, however.

Q. Well, it is not the distinguishing feature of the Mooers patent that it can be made with the permanent core? A. Distinguishing over Spillman & Mooers?

Q. Yes. A. Oh, no. That is not the only distinguishing feature. It is not only the different construction, but it is lighter and different mode of operation.

Q. The matter of whether a piston can be made with the permanent core is really a production proposition? A. Some times. Some times it is a matter of metal quality, too.

Q. The Mooers patent 1,402,309, page 3, lines 47 *et seq.* contains the following statement, after describing the operation in the preceding sentence, reading as follows: "Thus when this top zone of the guide heats up the resulting expansion can be accommodated by outward movement of the relieved part of the wall and danger of seizing, as a result of close engagement between the unrelieved part of said wall and the cylinder, is obviated."

The part to which I call attention reads as follows: "This action, of course, is made possible by the fact that the upper end of the guide section is not continuously joined to the head section, but, being separated from the head by the air gap, is free to take form in a measure independent of the head."

In the Spillman & Mooers structure, described as shown for instance in Figs. 12, 13, and 14, these connectors 3 are spaced around the piston circumferentially out of line with the wrist pin bosses? A. To which figure do you refer?

Q. Figs. 12, 13, and 14. A. Yes.

Q. Now, page 2, line 30 of the patent reads as follows: "It will be understood that this relationship might be that of a poor mechanical fit or joint which would be a poor conductor of heat, as compared with the metal of the head 2 and connectors 3, so that such heat as did pass from the head 2 to the skirt 1 would do so principally by way of the connectors 3, rather than from the head to the upper end of the skirt 1 directly." What do you understand by that statement? Does that mean an air gap, as, for instance, shown in the drawing, or some fit connection? A. That means the air gap, as I understand it.

Q. When he refers to a poor mechanical fit, doesn't he contemplate eliminating the gap and having the skirt and the head abutted right up against each other with perhaps some slight air gap between or perhaps a piece of asbestos between? A. No, I don't see anything that would suggest that. Where he states that the relationship might be that of a poor mechanical fit or joint, would be a poor conductor of heat, that is, I think he is merely stating a poor mechanical joint would be a poor heat conductor, and this acts in the same general way so far as heat conducting is concerned.

Q. He is intending to disclose something, or did intend to disclose something else than an air gap? A. Where?

Q. In that part he contemplated something else than an air gap? A. I don't see any place.

Q. I mean in that particular sentence there. A. Oh, I think not, except merely to refer to how the air gap functions as a heat conductor.

Q. You would think then that the sentence there is superfluous? A. I think it is explanatory.

Q. Now, as a matter of fact in the Mooers patent structure the connectors 3 are restricted heat flow connectors, aren't they? A. In part, yes.

Q. Do you really think much of that patent, the Mooers patent, as an advance in the art over the Spillman & Mooers patent, from the engineering standpoint? A. Not the completed result, no. That is, if the thing had been stopped there, the final result as we now know it would not have been achieved. But there are elements

of construction in the patent which are very important.

Q. Well, it is sufficient to hang the claims on, isn't that right?

Mr. Richey: Oh, I object to that. Why ask the mechanical expert those questions about that?

The Master: He may answer. Overruled.

A. I think the disclosure, so far as I am aware, is the first one which covers a piston of light weight with a head substantially cut away from the piston so as to keep the skirt temperature down in part, and yet sufficiently connected to take care of mechanical stresses, and at the same time guide the heat into the skirt and compensate for the extra expansion which results from that extra temperature and also allow for distortion of the skirt at the top where it is the hottest and where clearance is hardest to provide. The same principles are combined with other factors in the commercial pistons of today.

Q. But the statements you have just made, how does that distinguish from the Spillman & Mooers patent structure? A. Well, the Spillman & Mooers structure is of course entirely different from that of the Mooers. The connection between the head and the skirt is made from the flat disk of the head to near the bottom of the skirt, and the connection of metal on the head proper is continuous and the connection on the skirt at the bottom is continuous; so that from the standpoint of construction they are entirely different. Now, from the standpoint of mode of operation they are entirely different. The Spillman & Mooers construction does provide for keeping the temperature of the skirt down, especially in so far as the mechanical expansion is concerned. Even in the Spillman & Mooers the top of the skirt must get pretty hot, because the piston moves up and down in the cylinder. When the piston is at the top of the stroke and the explosion occurs, the gases are heated to a very high temperature and they continue to exert pressure on the piston as it moves down the barrel. So that at the bottom of the stroke, perhaps, the piston would be in some position like that (indicating with physical exhibit on chart Exhibit 14), and the hot gases are all in here on the cylinder wall. Now, as this piston moves upward, the heat from the walls is given directly to the skirt, particularly at the top, whereas the bottom of the skirt may not get so hot because it works up and down in a region where the hot gases never have the opportunity to

heat up the cylinder walls. So that does not mean there is no expansion problem in this Spillman & Mooers construction. Furthermore, the Spillman & Mooers operation is one in which the whole side thrust from the explosion stroke must be taken from the pressure on the head to the support at the bottom of the skirt, and the full head section acts as a cantilever in the operation, and one can take this piston,—I can take it in my two hands—and weave it; you can see that whole head weave with respect to the top of the skirt. Now, you could not do that with the Mooers construction, so that the mode of operation is different.

Q. Then the Spillman & Mooers piston is, in plain language, no good? A. In this particular form I think it would function probably a little better than the trunk type piston, but perhaps extra care would be required in fitting the head portion, which is not required in the Mooers construction alone.

Q. But the structure, function, and mode of operation is different from that of the Mooers; is that right? A. Yes.

Q. You understand, of course, The Cleveland Trust Company brought suit on that Spillman & Mooers patent on account of the making of this particular piston in suit?

Mr. Richey: We have been over that once.

Q. But you understand further that in order to establish infringement, structure, mode of operation, and result must be the same; and do you still say now the structure, mode of operation, and result of Spillman & Mooers is different from that of Mooers? A. Yes, I say that.

Q. Is it your opinion, Dr. Jeffries, that Defendants' Exhibit BBB incorporates the features of the Mooers patent 1,402,309? A. Yes.

Q. Will you tell me why? A. Because the connection between the head and the skirt has been moved to the inside of the piston structure, the same as is shown here on Mooers.

Mr. Richey: Referring to Fig. 1 of Mooers.

The Witness: Yes, Fig. 1.

Mr. Richey: Point 3.

The Witness: In Mooers, at the horizontal slot. And because the head is partially cut away from the skirt, leaving the air gap on the greater portion

of the circumference between the head and the skirt, and because of the places where the connections are between the head and the skirt, the skirt section is relieved for the purpose of allowing for extra expansion of the piston at those points.

Q. I show you a cross-section of a piston corresponding to Exhibit No. 1. That corresponds substantially, doesn't it, with Exhibit 1, that cross section? A. Yes.

Q. It is intended to, anyway.

Mr. Bruninga: I want to mark it for identification Defendants' Exhibit 3G.

(So marked.)

Q. Now, compare that with Exhibit EEE, and you find that in both cases there is a connector from the head to the skirt, in Exhibit 3G it is partly from the ring flange and partly from the head, while in Exhibit EEE it is from the head; that is the general distinction, isn't it, the connection?

Mr. Richey: I object to that question as it relates to the prior art of the Spillman & Mooers patent. If he did have any right to inquire about that with respect to Mooers, which I challenge, he certainly hasn't any right to talk about the prior art in connection with these other pistons of the patent.

The Master: The same ruling; he may answer and you may have your exception.

A. What I have said might indicate that this connection directly to the flat portion of the head in Defendants' Exhibit 3G is the main part of the connection between the head and the skirt, which of course it is not. The main part of the connection between the head and the skirt in Exhibit 3G is the metal between the ring flange and the skirt rather than metal from the flat of the head to the skirt; whereas in the Spillman & Mooers the connection is entirely from the flat of the head to the skirt, and then the connector goes way down and nearly to the bottom of the skirt, whereas the connector in Exhibit 3G is only the width of the slot.

Q. In other words, the connection to the skirt is made higher up in 3G? A. Yes, a different order of magnitude as to distance.

Q. Well, it is higher up? A. Very much higher up, yes.

Q. But in each case, 3G and EEE, the wrist pin bosses are carried by the connector or by the webs, you may call them? A. Yes; the wrist pin bosses are carried in the web in Exhibit 3G, but hardly in the connector in 3G, if we consider the connector only of length equivalent to the gap at the head, whereas the connector in the Spillman & Mooers is equal to three-fourths the length of the piston.

Q. You define the connector then as being where the bottom connects to the skirt or where the top of that connects to the skirt? A. Well, I would say that the connector, so far as its business function as a connector is concerned, would be limited by the two parts which are connected. So the connector in the Spillman & Mooers is seven-eighths the length of the piston, or three-fourths, whereas the connector proper in Exhibit 3G is on the order of say a quarter of an inch.

Q. That is a matter of words, isn't it, Doctor? A. Oh, it may be, but the constructions are there and clear and any one can see what they are.

Q. The two constructions look deceptively alike, don't they? A. No, not to me.

Q. You think the construction in the Mooers is more like 3G than EEE? A. Whether it looks like it or not, it surely is.

Q. Now, the flow of heat from the head to the skirt, whether we take it through the medium of the ring flange or any other way, is downwardly around the wrist pin boss to the skirt in either case, isn't that right? In other words, you have got this branching of the skirt around the wrist pin? A. Why, no; in this Exhibit GGG most of the heat that goes from the head to the skirt shunts the wrist pin boss.

Q. And it doesn't at all in the Spillman & Mooers boss? A. Well, it can reach the skirt through a very short channel in Exhibit 3G, and it must go below the wrist pin boss before it can reach the skirt in the Spillman & Mooers construction.

Q. But there is a heavy thermal connection, heavy metallic connection, between the head and the top of the wrist pin bosses in 3G; isn't that right? A. Well, it is fairly heavy, yes, but there is a short connection from the head across to the skirt, and the length of travel is very important in heat conduction.

Q. Now, in the Spillman & Mooers construction there is actual relief in the skirt opposite the wrist pin

boss? A. Not so intended. There is a hole for putting the wrist pin in.

Q. You wouldn't call that a relief because it is a hole; but you would call it a relief if it is a hole which is widened out at the top as in the Mooers patent? A. Well, I would call it a relief when the patent says it is a relief for that particular purpose. But we know there would be no way of getting a wrist pin into this piston unless the skirt were cut away.

Q. Would the skirt have to be cut away more than the diameter of the wrist pin, if it was widened? A. Not if the casting on the inside had been relieved from this skirt. (After examining) But I suspect the easiest way to cast this would be to cast the skirt and the outer end of the boss integral and cut them away later.

The Master: You are looking at Exhibit what?

The Witness: Spillman & Mooers piston Exhibit EEE. I am not sure how that was done in that exhibit.

Q. But the patent does show, the Spillman & Mooers patent 1,092,870, does show considerably enlarged openings 13 in Fig. 2? A. Yes; but it has no function; it has no work to do in this patent, in this construction.

Q. And in the Gulick patent piston the hole 24 is rather small, just enough to get in the wrist pin; is that right? A. That is correct. No relief is contemplated in the Gulick patent, in the Gulick construction shown.

Q. But at least one of the purposes of the hole in the Spillman & Mooers construction is to permit oil to enter through the hole 13 in Fig. 2, that is clear from page 1 lines 99 to 101? A. Yes, it is so indicated.

Q. One of the distinctions that you pointed out is that in the Mooers patent structure the connectors spring from the ring flange rather than from the head itself in the Spillman & Mooers patent; that is one of the distinctions, isn't it? A. Yes.

Q. But still you contend that the Ray Day construction in which the connection springs right directly from the head, that still embodies the features of the Mooers patent? A. Yes.

Q. So the matter of springing the connectors from the head is not of so much importance? A. Well, that is in combination with the boss relief in the Ray Day construction.

Q. Now, in the Ray Day construction what you really have is a boss connected with the skirt, with the connector coming down and connected at one side, and at the other into the boss. You have in the Ray Day construction, as compared with the Mooers patent structure, Fig. 1, a boss connected with the skirt, but the connection from the head to the skirt is made to the boss, to the inside of the boss? A. Yes, that is true.

Q. That is about as different from the Mooers patent structure as you can imagine; is that right? A. No.

Q. You think the flow of heat will be the same? A. Not exactly, no.

Q. As a matter of fact, isn't the Spillman & Mooers patent structure closer to the Ray Day than you can say of the Mooers patent structure? A. No.

Q. You still contend that there is greater similarity between Ray Day and Mooers than there is between Ray Day and Spillman? A. You have short connectors in the Mooers, for one thing, and the direct flow of heat to a certain spot, and then you relieve around that spot. Those things are in combination in Mooers; they are not covered at all in the Spillman & Mooers; and they are present in the Ray Day piston.

Q. Even though the connection would flow the heat from through the wrist pin boss in Ray Day and directly through the skirt in Mooers? A. I think so.

Q. Now, in defendants' piston structure as compared with the Mooers structure, the connection is made at two wide connecting zones; isn't that right; one on each side? A. They are connecting zones and they are wider than the connection shown in the Mooers drawing.

Q. Would you say just a little bit wider? A. No; you have two connectors in the defendants', and the drawings in the Mooers show four. Taking the total connections, it is probably not a great deal different.

Q. In defendants' construction, as you have previously stated, it is your position that there is a branching flow around the wrist pin boss from the head to the skirt? A. That is correct.

Q. But in the Fig. 1 construction of Mooers, why the connections are directly above the wrist pin bosses? A. Two of the connections, but they reach the skirt before they do the bosses.

Q. Do you know whether the Mooers patent structure has ever gone into commercial use? A. No, I do not; just as it is shown there. If it has been used, it has been very small.

Q. You know it is the first patent that went into the Cleveland Trust? A. No, I didn't know that.

Q. You didn't know that. Now, take up next the Schmiedeknecht patent. Schmiedeknecht's purpose was really to reduce weight, wasn't it? A. Yes, it was.

Q. And for that purpose he cut holes in his piston 16? A. That was one of the things he did, yes.

Q. You weren't familiar with the piston business in 1917, were you? A. Yes.

Q. Quite common to cut holes in pistons, wasn't it? A. Yes, it was to make what is known as skeleton pistons; even bored holes in the skirt.

Q. You called attention on direct examination to the skeleton piston construction, what that construction was, and as I understood, it was used long prior to the patents in suit? A. Yes.

Q. What was one of these structures? A. Well, a skirt with the holes boxed through it.

Q. And that is just about what the Schmiedeknecht amounts to? A. No.

Q. One big hole instead of a little, small one, or two big holes? A. No; I think Schmiedeknecht recognized the more basic difficulty in the construction of thin-walled pistons, namely, that the thin-walled skirt was not sufficient support for bosses by cantilever construction; that is where the bosses are suspended entirely from the skirt walls.

Q. But that has been retained in cast iron pistons to this day, hasn't it, the so-called cantilever construction? A. Not only has it been retained, but the heavy-walled cast iron piston has also been retained. That is, the difficulties of making a light weight cast iron piston apparently are too great for the industry to solve at the present time. When they want light weight, they go to aluminum.

Q. You and I were both then looking at the piston head of the piston I have in my hand. That is the general old cast iron piston that has been in use for a long time, the general structure, I don't mean the details? A. Well, I don't know as to the detail of the inside construction. It will be noted that the boss is ribbed in the piston which you have in your hand, which apparently has no exhibit number.

Mr. Bruninga: I mark the same for identification as Defendants' Exhibit 3H.

Q. It was quite common to rib bosses like that in 1917, wasn't it? A. I don't recall.

Q. Now, Mr. Schmiedeknecht absolutely wanted to avoid the use of aluminum, didn't he? A. He apparently wanted to make a light weight cast iron piston, that is correct.

Q. Now, as a matter of fact, Mr. Schmiedeknecht supports his wrist pin bosses between a web and a head; in other words, at the end of the bosses? A. In the drawings shown, that is true.

Q. Does he describe anything else; does he even intimate he wants to support it in any other way?

Mr. Riehey: I object to the question as immaterial. The patentee is entitled to his equivalents whether he describes it or not.

The Master: Same ruling; he may answer.

A. I see no specific reference to any other general type of construction. The wording, of course, is susceptible of some latitude, but so far as specific description of any other kind of connection is concerned, I see none.

Q. When you say the wording is susceptible of some latitude, what do you mean? A. Well, take for example, the sentence beginning line 102, "The inner end of each of the bearings is supported by a transverse bridge or truss 21, joined respectively, centrally to the bearings and terminally to the edges of the portions 17 of the apron of the piston."

Q. But that is immediately preceded by this part, and I will read the entire quotation, beginning with line 97: "Alined bearings, 19, each of which has a suitable bore, 20, for the reception of a piston pin, are attached at their outer ends to the head sections at the upper edge of the openings, 16, centrally thereof." Then follows the sentence, "The inner end of each of the bearings is supported by a transverse bridge or truss, 21, joined respectively, centrally to the bearings and terminally to the edges of the portions 17 of the apron of the piston." There is a very clear statement that you have a boss supported at its ends rather than in the center? A. That statement so indicates, yes.

Q. Do you find any statement, even in any claim—I am not asking you to interpret claims—do you find any statement in any claim that indicates that anything but end supports of a bearing are contemplated by the patentee?

Mr. Richey: I object to that; that is asking him to interpret the thing.

The Master: I will interpret it when the time comes. He may answer the question. Objection overruled, and you may have your exception.

Q. You can limit yourself to claims 1 and 3 because those are the only ones involved in this suit. I don't want you to interpret claims at all. A. Well, I don't know, such a phrase "the transverse bar adapted to support the inner end of said bearing" just what that would mean.

Q. Well, "alined bearings the outer ends of which are suspended from said head section within said opening, and bridges sustaining the inner ends of said bearings." Wherever language of such kind may occur, certainly describes a bearing supported at its ends rather than at the center?

Mr. Richey: Same objection.

The Master: Same ruling.

A. Well, it implies a structure which suspends the inner ends. I don't know whether it implies a junction at the inner ends or not.

Q. You want to make that distinction? A. I don't know.

Q. I mean you want to make that distinction in English that a thing might be suspended? A. Is suspended at the center. I don't think it says it is suspended at the ends. It says it suspends the inner ends; I think so.

Q. You say then that the boss which is supported intermediate its ends on a wall or a web or a bridge is the same structure as a boss supported at its ends at two points of suspension?

Mr. Richey: I object to that as immaterial. There is no such structure involved here.

The Master: That follows from his answer, I think. He may answer.

Q. I am comparing now, Dr. Jeffries, if you are in any doubt about it, the Plaintiffs' Exhibit 1 with the Schmiedeknecht figure 4? A. Well, I should say that that is pretty close to the Schmiedeknecht actual wording and drawing disclosures, inasmuch as you have the boss at its upper end even supported by this rib which comes out nearly to the outer end, but it is distinctly, on the inner end, supported by the web.

Q. You go still farther then and say that a structure which consists of a description which states that a part is supported at its ends, is supported at its ends because it is supported all the way along? A. No, even the Schmiedeknecht drawing, Fig. 4, doesn't show the web at the outer ends of the bosses; it shows an overhang of the boss beyond the webs. Now, I think there is no distinction there as to just how far the overhang must be, or whether there should be overhang or not.

Q. As far as you look at the structure then, the structures are the same whether the boss is supported intermediate its ends or at its ends; that is the way you view it? A. Well, the drawing, if you want to get down to fine hairs, is intermediate the ends, isn't it? That is, Schmiedeknecht drawing No. 4. It is intermediate its ends, if you want to split hairs.

Q. But you would consider then a structure like Defendants' Exhibit 1, in which the boss is supported almost at its middle, the same elemental structure as for instance shown in the Schmiedeknecht patent in which it is at least supported at spaced points? A. Well, I should say that that structure could well be interpreted as the Schmiedeknecht structure, not only as a structure but in combination with that total web and the opening in the skirt between the web and the skirt below the boss; that whole thing is shown in combination in Schmiedeknecht and it is shown in combination in Defendants' Exhibit 3-G.

Q. But you don't consider the Ray-Day, in which the web is connected at both ends, one end at the skirt and the other to the head, as embodying any of the improvements in the Schmiedeknecht patent? A. Well, I should think not. That doesn't appear to be the Schmiedeknecht structure to me.

Q. Now the Schmiedeknecht patent structure also has a groove running all the way around, an oil groove? A. It has a groove in the slotted metal running all the way around, that is true.

Q. Part of it don't run out in the air? A. No.

Q. Is there any difference in that respect, then, whether part runs out in the air or does not run out in the air? A. Yes.

Q. You think so? A. Yes.

Q. What difference does that make? A. Why, it makes a difference in the mode of operation of the piston, if part of the groove goes clear through, the heat conduction from the head and the skirt is minimized at those places, the temperature is lowered, and there is

also the distortion at the top of the skirt due to difference in temperature, and, broadly, the various functions which I have previously discussed in connection with those horizontal slots.

Q. But Schmiedeknecht indicates a number of holes, 15? A. Yes, oil holes.

Q. He don't say how far he wants to place those holes? A. No.

Q. He might place them close together? A. He probably has got a pretty fair indication of them in the drawings.

Q. They would restrict the heat slightly? A. A little, but uniformly, again, around the periphery.

Q. Schmiedeknecht doesn't say these holes should be around? A. No, he shows them around, however. There is clearly no indication of a separation between the head and the skirt in Schmiedeknecht.

Q. You say there is no separation because he don't describe it in the specification? A. He doesn't describe it and he doesn't show it in his drawings.

Q. But as a matter of fact there is some separation, would you say 10% from the drawings, the size of the holes? A. I don't know. Whatever he has there is old and the same kind of separation we find in practically all pistons as shown in these various exhibits, well known oil holes.

Q. You say those were well known oil holes before Schmiedeknecht, is that what you want to imply? A. Yes.

Q. And well known oil groove for the oil to run back into the piston? A. There was grooving, yes; that has been used a long time in piston construction.

Q. The difference between Schmiedeknecht and Plaintiffs' Exhibit 1 is that Plaintiffs' Exhibit 1 has a T-slot in one of its faces, that is one difference, isn't it? A. Yes, it is, a horizontal slot at the top of the skirt and a longitudinal slot through the thrust faces.

Q. And such a T-slot could be applied to Fig. 2 of Schmiedeknecht? A. Oh, one could make sufficient modifications of the Schmiedeknecht drawings to make this piston, yes, if he made a lot of changes in it and included the inventions of Maynard and Jardine.

Q. I am not asking you that at all, I am asking you whether it would be impossible to take the Schmiedeknecht Fig. 2 and put a T-slot on it with the horizontal of the T below the lowest ring land, and with the vertical

of this T extending to the end of the skirt? A. No, one could do that with a hack saw or in a lathe, that wouldn't be impossible, if you knew how to do it, and the material were machinable.

Q. And such an arrangement corresponds generally to Defendants' Exhibit BBB? A. No, it does not.

Q. What is the difference? A. One difference is that the Schmiedeknecht construction, slotted as shown, would not provide relief in the axis of the wrist pin at the top of the skirt, and the slotting would increase the temperature at those particular places, increase the expansion, and seizure would result.

Q. There is keystone relief provided in the Schmiedeknecht patent? A. Yes, but it is not in the right place for the flexible skirt piston.

Q. Isn't the relief in the zone of the wrist pin bosses? A. Yes, but that is not where the relief in such a piston is most needed. It is most needed at the very top of the skirt.

Q. And Mr. Schmiedeknecht didn't provide for that? A. He did not.

Q. Do you know whether the Schmiedeknecht device ever was in commercial use? A. No, I do not.

Q. Do you know that it has not been in commercial use? A. I don't know that it has not or I don't know that it has.

Q. Did you ever meet Mr. Schmiedeknecht? A. No.
(Short recess taken.)

Q. Taking up the Maynard patent, 1,655,968, Maynard really describes as his principal feature in the specification, the provision of an oil groove around the skirt, doesn't he? A. I can't say that is the principal feature. The piston is a combination of many features.

Q. Well, I am asking you about the specifications as you have read them. Do they stress, do the specifications stress this so-called continuous groove around the top of the piston? A. Among other things, yes.

Q. Well, would you say "among other things" when probably 90% of the specification is directed to that?

Mr. Richey: I object to counsel's testifying. He asked the witness about it and then testifies himself, and besides it is not correct.

The Master: Well, he may answer.

A. No, I merely say that is one of the features of the combination which makes up the total construction of the Maynard piston.

Q. Well, the specification states, beginning line 70, page 1: "With the construction as described, when the piston is in operation, the lubricant upon the wall of the cylinder is spread by the skirt portion of the piston and will be forced upward to the groove E at the upper end of the skirt. At no time is there a body of the oil adjacent to the piston rings and for this reason when the engine is upon suction stroke, any leakage past the ring cannot draw oil upward." Doesn't that describe exactly what takes place in the Schmiedeknecht patent structure with its oil groove? A. Well, the first sentence of what you read, five lines or such a matter, refer to the full skirt, I think, at the bottom of the piston, how that skirt spreads the oil, and then the next thing is the function of the oil groove.

Q. Well, you have both the skirt and oil groove, the skirt part 18, and the oil groove in the Schmiedeknecht patent? A. You have the skirt and the oil groove, that is true. The oil groove is not the same as it is in the Maynard patent, nor is the oil groove in the Maynard patent confined to its functioning in the prevention of oil pumping; it has other functions.

Q. Well, let's leave out all the other functions for a minute, let's get down to the matter of its function as the oil groove in the prevention of oil pumping. You have in the Maynard patent structure a groove which the patent at least says goes completely around the skirt at the bottom of the ring lands, the groove being shown at E, and you have at least a similar groove in the Schmiedeknecht patent which does go completely around and does not go out into thin air for half of its circumference? A. Insofar as the groove is concerned, that is true.

Q. Is there any advantage in having it go out into thin air for half of its circumference? A. In the oiling?

Q. Yes. A. I think that is essentially a matter of whether the oil can get away to the inside of the cylinder, which you can do in the oil groove of Schmiedeknecht or through the openings in Maynard, the wide opening.

Q. But there is no essential difference between the two constructions as far as the spreading of the oil on the cylinder or preventing oil pumping? A. Well, I can't say that; the spreading of the oil would be about the same in both constructions.

Q. And the oil in both constructions would flow back into the inside of the piston through the oil groove? A. It should if everything functions properly. Of course

there is much more space for it to flow back in the Maynard construction than there is in the Schmiedeknecht construction.

Q. The patent further states: "As a further safeguard, the cylindrical portion below the lowermost of the ring C is cut away to provide a further clearance, as indicated at J, this clearance being sufficient to prevent the bridging of the oil thereacross." You don't find that in the Schmiedeknecht patent, do you? A. No.

Q. But can you tell me, as one skilled in the art at that time, whether that particular feature was a common practice? A. I don't know whether it was or not.

Q. You don't know whether that was done with pistons in 1920 or '21? A. No.

Q. The specification then proceeds: "Thus on each downward stroke of the piston, the lowermost ring will scrape all surplus oil from the surface of the cylinder and in the upward stroke the oil thus accumulated will pass through the groove E and downward. Any oil accumulating in the recesses H will follow down the webs F and there is no chance at any point for the accumulation of oil adjacent to the rings." Doesn't that take place in the Schmiedeknecht patent? A. I should say, broadly speaking, yes.

Q. We have in both, of course, an open space, the open spaces 16 and H of Schmiedeknecht and Maynard correspond? A. In the Maynard drawings, yes.

Q. Would you say that the Maynard patent structure is a slipper piston? A. No, I wouldn't call it a slipper piston.

Q. But you said it was like the Jardine patent structure? A. From the boss up, approximately; I said that.

Q. And from the boss down it is like Schmiedeknecht? A. More like Schmiedeknecht, that is true, with the exception of course of the other features in Maynard not described in Schmiedeknecht.

Q. Maynard, then, really, is a hybrid of Schmiedeknecht and Jardine, isn't it? A. I wouldn't call it that. It is a commercially successful piston, combining a number of features.

Q. Well, the top corresponds to Jardine and the bottom corresponds to Schmiedeknecht; it really amounts to putting the part 18 of Schmiedeknecht onto the Jardine slipper piston? A. Well, that wouldn't make a particularly good piston, just that.

Q. Why wouldn't it make a good piston? A. Because all these things have to function together or in com-

bination in order to make a successful piston. And one of the features of the Maynard piston is flexibility, and the flexibility of the skirt portion and the webs cooperate to produce the Maynard effect. So that the bottom of the Maynard piston must cooperate with the top of the Maynard piston to make it a commercially successful piston.

Q. Would you say, then, that the skirt of the Maynard is more flexible than the skirt of Jardine? A. Well, there is more skirt in the Maynard, and there is more requirement for flexibility, especially at the bottom of the skirt, because there is no relief at the bottom of the skirt, so that the requirement for flexibility is different in Maynard from what it is in Jardine, at the bottom of the skirt.

Q. You would contend, then, that the flexibility must be at bottom rather than at the top, in any piston? A. It must be wherever flexibility is required.

Q. Well, I am asking you, you say it should be at the bottom, the greater flexibility at the bottom than at the top in the Maynard piston? A. Yes, in the Maynard piston there is no other provision for compensating for clearance except the bottom of the skirt, except the flexibility.

Q. And the flexibility at the top is not so important? A. Oh, it is very important, but there are other features combining to compensate for the extra expansion at the top in the Maynard piston.

Q. But you don't have very much flexibility in the top at all, do you, in the Maynard piston? A. Yes, you have enough to make the difference practically between success and failure of the piston. That is, if the slot is not cut through on Maynard at the top of the skirt, there is not sufficient provision to take care of the excessive clearance.

Q. But you do not have such flexibility at the top of the Maynard skirt as you have at the top of the Jardine skirt? A. Well, that depends, I think, on the construction, depends on the thickness of the various parts of the piston.

Q. Well, as a matter of fact, slots 29 and 29' of Jardine do provide for definite flexibility of the skirt, don't they? A. Yes.

Q. And you don't have anything like that in the Maynard patent, do you? A. Yes, the same.

Q. Where do you have it? A. Well, the horizontal slot E in Fig. 1.

Q. Will you explain to the Court how it is physically possible to slot the skirt of either Exhibit 1 or Exhibit 17 at the top?

Mr. Richey: You mean Exhibit 1 when the—

Mr. Bruninga: When the slot is cut all the way through.

A. Yes. The horizontal slot which I am indicating with my pencil is the same as E in Fig. 1 of the Maynard drawing. The vertical slot which I am indicating with my pencil is the slot at I in the Maynard drawing. The skirt itself is made of metal which is quite thin, and the cylinder pressure against the face of the piston, say, in a direction perpendicular to I, will flex the sides of the skirt inwardly, which will compensate, in a measure, for extra expansion. There is also some flexibility of the skirt by virtue of the general flexing of the entire skirt as the result of cylinder wall pressure. This is sufficient at the bottom of the skirt to be readily seen with the pressure exerted with one hand.

Q. But the flexing at the top can only be the initial flexing of the cylindrical parts? A. Mostly, I won't say only.

Q. You want this Court to understand, then, that it is your opinion that these so-called webs flex? A. Some, yes.

Q. And even with the web length of one-eighth of an inch or maybe a sixty-fourth of an inch? A. The lever arm is not the particular length of the web, but it is the distance between the straight line connecting the two ends of the slot and the outer diameter of the skirt. I may say in that connection, however, that the compensation for the excessive expansion is, as a practical matter, taken care of. As to how much that is due to mechanical expansion and the distortion resulting therefrom, as to how much is due to the lowering of the temperature of the skirt itself at the thrust faces, as to how much is due to distortion due to mechanical pressure of the cylinder walls against the pistons, and the effective pushing out of the piston at points where it is relieved, and as to how much is due to the actual flexing due to the slots, I cannot say. Neither can our automotive engineers at the Aluminum Company of America who have been working with this problem for many years. But all of those things in combination provide a piston with low enough clearance at the top of the skirt so that

it doesn't slap when the piston is cold and it doesn't seize when the piston is hot.

Q. Let's leave out the question of the great commercial utility of this piston and let's get down to facts. The so-called webs in this piston in Exhibit 17 do not flex like contemplated in the Jardine patent, do they, at the top? A. Not as much as with the webs at the top of the construction shown in Jardine Figs. 6 and 7.

Q. Would you say even 1% as much? A. Oh, yes. I told you a while ago I cannot say what percentage is contributed by each one of these elements, I don't believe you can, either.

Q. I don't claim to be an expert, Doctor. The flexure at the bottom is due to the twisting of the whole structure, isn't that right, from the top to the bottom? The flexing of the bottom, that can be accomplished by simply pressing the skirt together with your thumb? A. Yes, that is true generally. The whole skirt contributes to that flexibility.

Q. And that same sort of an action takes place if you take BBB, which unfortunately is not slotted through, but which I am perfectly willing for you to have slotted through at lunch time or at any other time in order to suit yourself. A. That would be true of Defendants' Exhibit BBB.

Q. And there are no webs there to flex? A. There are the equivalent of webs.

Q. That is, the inside connectors? A. Yes, in effect, and the relieved portion around the bosses on that construction will function the same as the webs in the Maynard construction.

Q. You consider Exhibit BBB an equivalent generally of the Maynard patent construction? A. In part it is. It is an impairment of the Maynard patent construction.

Q. But nevertheless in your opinion it embodies the improvements of the Maynard patent? A. It will function the same as the Maynard piston and it will produce approximately the same results, but I believe with some impairment.

Q. Now, Doctor, I wish you would take a clamping device that I hand you and which I will mark for identification as Defendants' Exhibit 3-I. Will you demonstrate to the Court just how you flex those webs on Exhibit 17, particularly at the top, to close the slot at the top? A. I don't anticipate I can close the slot at the top with this device.

Q. Well, you can get a terrible leverage with that device, can't you? A. Considerable, yes.

Q. And you can get about as much pressure with that device as you ordinarily want to have in an automobile cylinder in which that piston operates? A. Possibly. This piston is cold, it is not in operating condition, no need for any flexing when the piston is at this temperature, no possibility of any distortion effect when a piston is all at the same temperature.

Q. But you don't think even with that device you can even appreciably close the slot at the top of Exhibit 17? A. Appreciably, well, I don't know, but I will say the difference of a thousandth of an inch in effective diameter is the difference between success and failure in piston improvement, and I would question whether you could see a thousandth of an inch movement with the naked eye.

Q. You think you cannot see any movement whatsoever? A. I don't know, I will try it. (Witness does so.) Oh, I can see lots of movement. You see about as much movement as with the hand operating the bottom of the skirt.

Q. Doctor, what you really did was to place it with the compressor handle in the line of the wrist pin bosses? A. Doesn't that compress circumferentially? (Showing to counsel.)

Q. But place it now with the compressor in the line of the slot, and see whether you can compress it? A. (Witness complies.) Yes, it is about the same. I can almost close the thing.

Q. You can almost close it? A. Yes. I should say that that is easily ten times as much as it would be called upon to flex in the motor.

Q. You think that that pressure you applied there is just about the pressure you would encounter in an automobile cylinder? A. No, I think that is probably ten times as much as would be applied in those particular directions.

Q. You think the pressure in the automobile is ten times? A. No, I think the pressure I applied there. I just mention that the degree of flexing is probably ten times as much as that piston would ever be called upon to flex in a motor.

Q. As a matter of fact, in the piston Exhibit 17 or Exhibit 1, the expansion is compensated for by this Keystone relief, I mean this Keystone structure on the non-thrust side? A. In part only.

Q. But that is the purpose of that tapered relief? A. The purpose of the tapered relief is to put less of a burden on the slotting and take care of more of the expansion in the ways mentioned.

Q. And in some of the pistons, this being a Ford piston, in some of the pistons that relief is accentuated more, as shown in Exhibit 17? A. Yes, it is a little, and in some there is no taper at all. In some the section there is rectangular.

Q. You said some of these pistons have been operated without this Keystone relief, some of these Maynard patent pistons? A. Yes.

Q. What company operated them? A. The Willys-Overland and the Oakland Company.

Q. When did they operate?

Mr. Richey: Just a minute, have you finished?

A. I heard your opening statement and I spent only about a half hour over to the Harvard Avenue plant of the United States Aluminum Company and looked up some drawings just to see whether I could find pistons that had been made and were commercial with the construction which you said was not commercial. So in that time I found the Overland piston and the Oakland piston which had not only been made but were production pistons, and I found a Packard piston which I do not know whether it had gone into production or not, but I made no attempt at an exhaustive search.

Q. You found actual pistons or drawings of pistons? A. I found the actual piston in the case of the Willys-Overland, and drawings in the case of the other two.

Q. Will you get that actual piston? A. I will try to, yes, sir.

Mr. Richey: You have asked for the piston or drawing?

Mr. Bruminga: The piston.

Mr. Richey: I think there would be a better chance of getting the drawing, if you want some evidence.

Mr. Bruminga: The drawing don't mean anything to me. Anybody can make a drawing. I would like to see the piston.

The Master: I think you may have the piston.

Q. Doctor, all of this type pistons that are used today have this Keystone relief? A. I am not sure, but I suspect so.

Q. Now, the pressure that you apply, that you said, that you indicated would close this slot at the top partially in Exhibit 17, how much of that was due to the bending of the segmental parts from the ends of the slot in? A. I don't know.

Q. You wouldn't, as an engineer, say, Doctor, that the webs from the center of the head to the end of the web, really flexed at the top in Exhibit 17? A. Not a whole lot, but they flex.

Q. Well, it is microscopic, isn't it? A. Well, I don't know why you insist on that because I have said that there are a number of things that contribute to that compensation for expansion, and I can't say what percentage this element contributes and what percentage another element contributes, but I have said that the webs flexed, and I have said that the skirt flexes.

Q. But you don't want to say whether it is microscopic or appreciable? A. Oh, I think it is not microscopic.

Q. Now, Doctor, the flexure of the skirt should be the greatest at the top, shouldn't it? A. Flexure—not necessarily. The compensation for excessive expansion must be greatest at the top, but the flexure need not be greatest at the top.

Q. Well, it is more desirable to have a flexure at the top than at the bottom, isn't that right? A. If you depend entirely on flexure for the compensation for excessive expansion, that is true, but only in that case.

Q. Well, as a matter of fact it is not really necessary to run this slot in Exhibit 17 down to the bottom of the skirt, is it? A. That is according to how closely you wish to work on the bottom of the piston, as far as fit is concerned, and also depends on the way the exterior of the skirt is ground. That is quite a broad question in itself, it is also one which involves economic features. This Maynard piston can be put into a machine and machined into two cylindrical portions, the head portion with a considerable clearance, and the skirt portion with small clearance, and then those slots can be put in and the piston can be put in the motor. There are other ways of taking care of the expansion at different places, by oval grinding and taper grinding and things of that sort, which increase the cost of a piston to the motor car manufacturer.

Q. Then the Maynard type pistons with which you have been familiar haven't been tapered, taper ground or taper finished at all, have they; they have been plain

cylindrical surface? A. Mostly, yes, that is true. If one is interested in a very fine fit, the other features can be incorporated. Some of the companies do that.

Q. But in your opinion in order to incorporate this improvement of the Maynard patent, is it, even on cylindrical surfacing, necessary to extend the slot to the bottom of the skirt? A. That depends again on the degree of fit, that is closeness of fit. If the slot is extended clear through it makes the fitting much easier.

Q. Now, in this piston like Exhibit 17, for instance, as the piston heats up, the whole structure, particularly in the region of the wrist pin bosses, tends to expand along the lines of the wrist pin bosses, doesn't it? A. Yes, it expands in all directions, but it expands more in the direction of the wrist pin bosses than in other directions, that is the slotted skirt type.

Q. And the effect of that is to throw these bearing faces against the cylinder, press them out against the cylinder, isn't that right? A. On the slotted side, that is true.

Q. And on the unslotted side also? A. No, on the unslotted side it tends to reduce the effective diameter of the piston.

Q. Pulls it in? A. Yes.

Q. Why is it, then, that this relief, this Keystone relief is put on the unslotted side? A. To provide some place for the highly expanded metal to go in the cylinder barrel. If there were no relief there would be no place for that extra expansion to go.

Q. But on the slotted side the relief is put in there in order to take care of the pulling out at the top of the structure? A. It serves the same general purpose as the relief does on the main thrust faces.

Q. The relief on the non-thrust, the split side, is for the same purpose then as on the other side? A. That is it serves that purpose. A piston at any given instant can be regarded as a rigid structure. Now, at another instant the shape of it may be a little different due to flexing, but insofar as it is at any instant a fairly rigid structure, the same rules apply on one face as on the other face.

Q. The Keystone is really the reverse in the Jardine patent? A. Yes, it is.

Q. Why is that? A. Why, I don't know just why, except that perhaps the particular web construction there in the Jardine requires a fairly wide distance between

the webs where they join onto the head flange, for economical manufacture, and for ease of removal of the core sections inside, and the width need not be so great at the bottom. And that perhaps is responsible for the structure shown there.

Q. Do you know Mr. Jardine? A. Yes.

Q. He is an engineer? A. Yes.

Q. And he would have some definite purpose for a thing like that, wouldn't he, a construction like that? A. Oh, possibly. The main purpose would be that such a piston would work in a motor.

Q. The Chrysler Company has used pistons like Exhibits 1 and 17, haven't they? A. Yes, like Exhibit 17.

Q. Do you know who furnished them? A. The Aluminum Company of America has furnished them, and I think the other suppliers have also provided the same piston.

Q. The Plymouth is one of the Chrysler cars? A. Yes.

Q. Do you know whether it is still used in the Plymouth? A. No, it is not.

Q. What type is used? A. A piston currently known as the T-slot piston.

Q. It is not a structure like shown in the Maynard patent, then, or in Exhibit 17? A. No, it is not the same structure.

Q. But Chrysler has a perfect right to use that particular structure, as you understand the situation?

Mr. Richey: I object to that. He is asking this man's conclusion about it.

The Master: He may answer if he knows. He has qualified as an expert on this.

Mr. Richey: He is not an expert on other patents not involved in this case.

The Master: He is an expert on pistons. This is a question of a piston on a car. He can give his opinion.

A. I think Chrysler pays a royalty on these pistons, all the pistons, as far as I know.

Q. Does Chrysler pay a royalty under the Maynard patent, is that your understanding? A. I suspect so; I am not sure.

Q. Did you know that Chrysler is a party to this suit, has been made a party to this suit or attempted to

he made a party to this suit, without its consent, and also as the owner of a half interest in the patents in suit?

A. Half interest of one of the patents, yes.

Q. But Chrysler, as you understand it then, has abandoned the use of this Maynard patent construction in the Plymouth car? A. It has in the new Plymouth car insofar as the typical Maynard construction is concerned. That doesn't mean that the Maynard patent may not infringe certain other patents that the Cleveland Trust Company holds.

Q. Now, how about the Ford 8; what type piston is that using, the exact construction? A. Oh, not the exact Maynard construction.

Q. Again it is a T-slot, isn't it? A. Well, I wasn't aware that that was a T-slot, but I thought that was a piston that was slotted, in which the vertical slot at least was completed.

Q. This is the piston being used in the Ford 8? A. Yes. The slot is completed, however.

Q. Oh, yes, that is what I understand.

Mr. Bruninga: The piston is marked for identification Exhibit 3-J.

Q. In other words, as I understand it, Ford abandoned what you call the typical Maynard patent structure since he put out the new eight cylinder car? A. For the eights only. He continued to use that in the new four. That is current in the new four.

Q. It is current in the new Ford? A. In the new four, as well as Model A. On 1932 Ford put out two new models, an eight and a four. This is the piston which he used in the eight, Defendants' Exhibit 3-J, but he continued to use the piston of the typical Maynard design in the new four, the 1932 model.

Q. Now, do you find any description whatsoever in the Maynard patent of this Keystone relief shown in Exhibits 1 and 171? A. Not what you call a Keystone in the wording, but the drawing shows that construction.

Q. And you would gather that from the Fig. 2 view of the patent? A. Yes, and Fig. 1.

Q. You don't consider that essential at all, do you? A. Well, I think it is preferable but it is not absolutely necessary. One should provide the necessary clearance by machining the vertical connection there, or rectangular connection, it is worded.

Q. Do you know Mr. Maynard? A. No.

Q. Never met him? A. No.

Q. The Maynard patent states, at page 1, line 12: "To avoid sticking or freezing of this skirt, due to expansion, certain constructions of pistons have provided the skirt with a longitudinal slot therein to compensate for expansion, but there is one serious difficulty with all such constructions, viz., the tendency for the lubricating oil to work up beyond the skirt and rings and into the explosion chamber." Is it correct that at the time that Maynard applied for his patent that was the practice?

A. At the time he applied there wasn't much practice on it, by the time he applied; but at that time I feel quite certain that he had the Jardine piston in front of him.

Q. You say he had the Jardine piston in front of him? A. I should think so.

Q. You know that, or is that just opinion? A. Well, the Jardine piston had been tested out in motors and was about ready to be adopted, I think, when this Maynard development came along.

Q. Was that Jardine piston sent over to Maxwell where Mr. Maynard was at that time? A. Well I don't know about that, but the piston was in the Aluminum Company laboratory, I think, at the time this application was filed.

Q. You have reason to believe Mr. Maynard saw that Jardine piston? A. Well, I believe it was. I was in the laboratory a good deal about that time and this was really a situation which gave us a considerable amount of concern, that is, the proper utilization of aluminum pistons in motors, and I recall the tests made on Jardine pistons and that it was thought that the Jardine piston would probably be adopted in the Maxwell production, and then the Maynard piston was forthcoming and the Maynard piston was the one that was adopted in the car.

Q. Was the Jardine piston tested out in the Maxwell car? A. It was tested out, I think in the Maxwell engine in our plant, whether it was tested in Maxwell cars or not, I am not sure.

Q. Maynard was chief engineer of Maxwell? A. He was an engineer there, according to the best of my knowledge; whether he was chief engineer or not I don't know.

Q. At the time the Jardine piston was being tested out? A. Yes, I think so.

Q. But did you have a Maxwell at the Aluminum Company plant to try out this Jardine piston in? A. I

don't recall we had a car, I think we had a Maxwell motor.

Q. And that particular Jardine piston was of the construction shown in the Jardine patent? A. As I recall it, substantially.

Q. Well, it had what you might say a slot across the top below the ring land and a vertical slot connecting with it to form a T? A. Yes.

Q. Then instead of taking the Jardine piston, the Maynard type piston was put into the Maxwell cars? A. Yes.

Q. So as you understand it, Mr. Maynard at the time he proceeded with the development was familiar with the Jardine split slipper piston? A. I think it is quite likely. I cannot say for sure; I think it is quite likely.

Q. Well, Mr. Maynard is dead, isn't he? A. I don't know.

Q. Mr. Jardine is alive, isn't he? A. Yes.

Q. Isn't he in the city? A. I think so. He was, earlier in the week.

Q. Is he still in the employ of Aluminum Company of America? A. Yes.

(Noon recess.)

(1:30 P. M., Friday, January 20th, 1933, hearing resumed.)

The Witness: May I make a statement here? Yesterday you asked me for a Silv-o-lite piston, and this morning for a Willys-Overland piston to which I referred in my testimony. I haven't been able to locate a Silv-o-lite piston but I have a photograph here on a piece of paper which I recognize as that of a Silv-o-lite piston.

Q. You saw that Silv-o-lite piston in San Francisco, didn't you? A. Yes.

Q. In fact they were some of the defendant's exhibits there at the trial? A. Yes.

Q. Just like shown on this photograph? A. Yes.

Q. Now, the main difference is that the bottom of the skirt, taking for instance Exhibit 1, is closed, that is the space between the web and the circumferential part is closed by metal, isn't that right? A. That is correct.

Q. Do you remember any other differences? A. Yes, there were downwardly extending recesses at the ends of the open parts of the horizontal slots, and also a

somewhat different configuration of the skirt portion itself.

Q. Can you tell me whether this is a Silv-o-lite piston, the exhibit I am handing you? A. Yes.

Q. I don't mean whether it is actually made by that company or whether it is the same piston? A. Yes, it is.

Mr. Bruninga: The piston is marked for identification Defendants' Exhibit 3-K.

The circular with the photograph of the piston is also marked for identification Defendants' Exhibit 3-L.

Q. And I believe you stated on your direct examination that those particular people were making this piston without authorization? A. I think so, yes.

Q. You will notice, particularly in this Exhibit 3-K, that there is no Keystone relief on the unsplit side and there is a distinct Keystone relief on the split side. Can you explain that from your knowledge as an engineer in this piston art? A. No, I don't know exactly what that difference has been put in there for, although the extra relief on the side which is to be slotted does make the skirt thinner and hence more flexible on the slotted side.

Q. It is a fact, isn't it, that all of these pistons that are split are furnished to the ultimate user, for instance to the garage man, in a partially split condition and that later your split is intended to be completed? A. That is usually the case, at any rate.

Q. Now, there are very heavy connections in this piston between the head and the web. A. It merely looks so from the outside, I think. There is an inside configuration which corresponds to the outside configuration, making the connection lighter than it appears.

Q. In order to obtain your opinion as to what the teachings of the patent in suit cover, can you tell me from looking at this piston whether it embodies any of the improvements in the Maynard patent in suit?

Mr. Richey: It seems to me that is going pretty far afield. Here is a device which is not charged to infringe here.

Mr. Bruninga: Does your Honor want to hear me on that, because I believe I can settle all this sort of questions? There is a definite principle of law established in practically every circuit and also in this circuit, to this effect, that if a plaintiff coming into court with a patent construes that patent to the

breaking point, the court is warranted in taking him at his word and holding that patent invalid. We are entitled to a construction of this patent from the court. I am not trying to get any opinion as to whether this infringes or not, but in order to determine just what the metes and bounds of these patents are we have a man before us who claims to be an expert and who can tell us whether they embody the improvements of the various patents. Now, that has been the purpose right along, for instance in my entire line of examination, for instance in connection with the Spillman & Mooers patent and other of that type, not going into the prior art, but getting this man's ideas of it. He is a man skilled in the art and he is the best one to tell us on behalf of the plaintiff.

Mr. Richey: It is not any different than in any other suit. There are certain definite issues. The issues are whether certain piston charged to infringe come within the patents. Manifestly under those circumstances neither party has a right to go along and inquire about a lot of things not before the Court. That is not any different from any other suit. It makes it endless. On his theory he could bring a hundred different pistons in here and ask this man's opinion as to whether they come within the patent. That is what he is starting out to do.

Mr. Brunsing: There is just another reason, your Honor, it has been represented to this Court that there is a certain party on the Coast who is making this stuff, probably without a license from the owners of the patent, and the plaintiff has tried to show to this Court that practically everybody has run to cover under these patents, that practically every piston made in this country today is made under these patents in suit. I didn't bring up the United Engine & Machine Company, this witness brought it up first in his statement that there were two parties on the Coast that were making pistons, and I believe he said, in defiance of the patents in suit. We can certainly inquire if they take the position that this is in defiance of the patents in suit, what those structures are.

The Master: I think he may answer. You don't need to spend a great deal of time on it. He may answer and you may have your exception, Mr. Richey.

A. I think the Silv-o-lite piston, when the slot is completed, embodies a number of the elements of the Maynard construction. It will function like the Maynard piston and it will produce substantially the result of the Maynard piston.

Q. Well, the answer to my question if it embodies any of the improvements of the Maynard patent, is that it embodies some of the improvements of the Maynard patent? A. I think it does.

Q. Would you say the same with reference to the Mooers patent in suit? A. I think so.

Q. And the same with reference to Jardine? A. Yes.

Q. The same with reference to Gulick? A. Yes.

Q. And the same with reference to Schmiedeknecht?

A. I am not so sure about the Schmiedeknecht on account of the closing of the webs below the bosses.

Q. In other words, when that opening is closed you don't have a web anymore, is that right? A. Well, when the opening is closed you don't have the cut-away part of the skirt below the web; it has been cut through.

Q. Now, before the recess we were talking about pistons— A. May I complete my statement?

Q. Oh, yes, certainly. A. You asked for a sample of the Willys-Overland piston showing the skirt portion at the top with the straight up and down section as opposed to the Keystone type of section. I was able to locate a rough casting of the Willys-Overland piston and also a rough casting of the Oakland piston with that construction. These are not completed pistons but when completed they have the horizontal slotting and one face has the vertical slot. I produce the Oakland rough piston casting and the Willys-Overland rough piston casting.

Mr. Brueninga: The castings are marked for identification, the Willys-Overland as Defendants' Exhibit 3-M, and the Oakland as Defendants' Exhibit 3-N.

Q. And these do not show the Keystone relief? A. No.

Q. Do you know, however, how they looked when they were finished, finally finished up? A. I don't recall that I have seen either of those in the finished shape, at least to examine them carefully.

Q. But it would be a simple matter to run a file along there in both cases to make a Keystone relief? A.

Machining could be so designed so as to give extra relief if necessary or desired.

Q. Just before lunch recess we were talking about the necessity of extending a slot to the end of the skirt, and at that time I was looking around for a piston that might illustrate it, that is, a sample so the Court could know, have a more intelligent understanding of what we were talking about. I show you a piston which I mark for identification Defendants' Exhibit 3-O. That structure was about what we had in mind, wasn't it, when we talked about extending the slot not to the end of the skirt?

Mr. Richey: I make objection to this. It is immaterial, going far afield; no such structure as that before the Court.

The Court: He may answer.

A. (After examining the exhibit.) Insofar as the through slots are concerned, I think you mentioned something about a slot which was not cut through the bottom, this piston has such a slot in it.

Q. That is an example of such an arrangement in which there is a T-slot and the vertical don't go to the end of the skirt? A. That is correct.

Q. Do you know whether or not Chrysler uses that particular piston in its Plymouth?

Mr. Richey: Same objection. It certainly is immaterial to any issue in this case whether Chrysler uses that or not.

The Master: Same ruling.

A. I think they do use a piston similar to this in the Plymouth.

Q. Now, in your direct examination you explained the utility of the Maynard piston in preventing oil pumping. I don't think I got a clear picture of that. Can you elaborate that a little bit, how oil pumping is prevented with this Maynard patent construction? A. Yes, I would compare it with the construction shown in Jardine, Figs. 6 and 7. When the oil is sprayed or splashed or thrown against the cylinder walls in the Jardine construction, it is not spread evenly over the wall of the cylinder, especially in the parts not traversed by the rings, and that causes an uneven distribution of the oil in the cylinder which makes it easier for the oil to by-pass the rings and get up into the combustion chamber. One function of the large bearing at the bottom of the skirt in Maynard

is to spread that oil evenly on the cylinder wall, which makes the accumulation of oil at the ring groove sections more even and thus militates against the oil passing the ring section up into the combustion chamber.

Q. Isn't that the function that is also performed by the ring I in Exhibit 14? A. Yes, it is.

Q. And that is known as an oil ring? A. Yes.

Q. And that is quite ancient? A. I think it is.

Q. Anyway it goes back of the Maynard patent?

A. Well, I am quite sure that it does, yes, according to my knowledge it does.

Q. So what Maynard did was to add an oil wiper to the Jardine piston, is that right? A. That is one of the things that he did. He made it integral with the rest of the piston, for one thing, and he produced a better guide for another thing.

Q. And that is exactly what we had in Schmiedeknecht, Schmiedeknecht does the same thing, doesn't he? A. Insofar as the oil distribution is concerned, the Schmiedeknecht skirt bottom should do the same thing. It is not a flexing skirt, however.

Q. Because it is not split? A. Well, it is not a flexible skirt.

Q. Well, that is because Schmiedeknecht's is not split? A. That is a true statement, I merely make the mention that it is not a flexible skirt, whereas the Maynard skirt bottom is a flexible skirt bottom.

Q. But you have noted the Maynard patent specifically stated the splitting of the skirt is known to him? A. Noted what?

Q. That the splitting of the skirt has been previously practiced, when he says in his specification, at page 1, line 13: "To avoid sticking or freezing of this skirt, due to expansion, certain constructions of pistons have provided the skirt with a longitudinal slot therein to compensate for expansion, but there is one serious difficulty with all such constructions, viz, the tendency for the lubricating oil to work up beyond the skirt and rings and into the explosion chamber." Did you have that in mind, that Maynard knew as a matter of fact that splitting of the skirt had been resorted to, when you gave your answer Schmiedeknecht didn't split his skirt? A. I think that is a fact, at least that is stated in the specification.

Q. Is it your position that the split in these pistons should be on the non-thrust side? A. That is best, yes.

Q. And by the thrust side we mean the side of the piston that is forced against the cylinder during the explosion stroke? A. Yes.

Q. Now, that is not universally the practice, though, is it, to place those splits on the non-thrust side? A. They have been placed on either side and on both sides, but it is the common practice, I think, to put the flexible, vertical slot, at any rate, on the side of minimum thrust.

Q. And that is the universal practice even today? A. Well, I don't know of any other construction at the moment.

Q. Do you remember the Packard, where the Packard places the split of the piston? A. No.

Q. You don't know then that they place it on the thrust side? A. No.

Q. Now, in this Jardine patent the statement is made, last paragraph on page 2 of the specification: "While I have shown my invention applied to the slipper type of piston as distinguished from the skirt type it is to be understood that the invention is essentially applicable to other forms of construction, the scope of the invention being indicated by the appended claims." Is it your understanding from that that this feature may be applied to the ordinary skirt piston the same all the way around, the Jardine patent feature? A. Well, I think certainly the Jardine features can be so applied, yes.

Q. And that would mean continuing the circumference of the slippers in Fig. 8, for instance, so as to make a skirt? A. No, at least unless relief were provided in that region, it would not embody the Jardine disclosures, as I read them.

Q. Now, in the Jardine construction both slippers are slotted, are they not? A. They are so shown, yes, in the drawings.

Q. In fact the specification states distinctly, page 1, line 75: "The segments of each pair are separated from one another by a longitudinally extending slot 12, said slot preferably being inclined or spirally arranged as shown"? A. That is correct.

Q. He don't point out any particular virtue of only splitting one of the slippers? A. I think not.

Q. In fact, Jardine describes in his specification that the larger slipper 30, Fig. 8, for instance, is on the thrust side? A. I think so, on the side of maximum thrust.

Q. And that side is split? A. Yes.

Q. As well as the non-thrust side? A. Yes.

Q. Now, Mr. Jardine in his patent refers to a proportioning of web thicknesses, page 2, line 34, in order to permit flexing of those webs. There has to be some proportioning, as he describes, in order to secure that flexing, isn't that right? A. Yes.

Q. The proportioning of thickness cannot be ignored at all if you desire a flexible web? A. No.

Q. And Mr. Jardine also described the webs as being definitely separated from the head by slots 29 and 29a in Fig. 6, and that is also necessary in order to really get a springing of those webs, flexing of those webs?

A. At the top, yes.

Q. Now, there are two constructions illustrated in the Jardine patent. In one construction, as shown in Fig. 2, for instance, these webs extend directly from the head, isn't that right? A. Yes.

Q. Somewhat comparable in that respect with the direct connection in the Spillman & Mooers patent? Oh, I don't mean as to details but I mean just as to that feature? A. Yes, more particularly, however, in the Gulick.

Q. Well, I expected you to say that. Now, in the construction shown in Fig. 7 the webs are connected with the ring flange? A. Yes.

Q. He really describes those as equivalent constructions, doesn't he? A. I am not sure that he does. I think he describes them as two separate constructions. He describes Figs. 6 to 9 as a modified form of piston.

Q. Now, in both constructions there is a cross web or rib, whatever you may call it, 27, Fig. 7, or 9, Fig. 1, which connects up with that web? A. Yes.

Q. Now, the Jardine patent says at page 2, line 76: "It will be seen that this last form of construction is based upon the same principles as the first form and further detailed description is therefore unnecessary. The main difference between the last form of construction and that first described resides in the webs 35 which support the wrist pin bosses and the guide portions, said walls being joined to the head structure at the lower edge of the ring flange 23 rather than springing from the head disc as in the first form of construction." Now, when he says it is based upon the same principle, isn't it your understanding, then, he considers those two constructions equivalent, whether he brings the webs right

from the head with the cross rib or brings them from the ring flange with the cross rib? A. Well, I don't think that is a justifiable conclusion necessarily. At any rate certain of the features would operate substantially the same in the two constructions. The main advantage over 6 and 7, as I see it, is that there is a truly single-walled construction in which the various parts cooperate to make for both the strength portions and the bearing portions and the flexible portions of the piston, and that piston can be manufactured in permanent molds, readily, whereas the other one cannot be readily manufactured in a permanent mold.

Q. Another point is that Fig. 7 looks somewhat more like the Maynard patent construction, while the other figure, Fig. 1, looks somewhat more like the Spillman & Mooers, as far as whether the attachment is from the ring flange or from the head itself? A. Well, I think it may be assumed that having gone to the trouble of showing the two forms, that it was considered that they were sufficiently different to warrant making the drawing and description.

Q. And also that they were sufficiently similar to include in the same patent? A. I think so.

Q. I believe you called attention to the ease of casting and particularly this nice little rounded fillet in the neighborhood of 28 and 28a, Fig. 8. That is made rounded like that rather than overhanging in order to get the mold half away from the piston? A. Yes, it is.

Q. You don't consider that that required a lot of ingenuity, do you? A. I don't think that that is my province. A lot of these things that seem simple, seem to have escaped the imagination or the efforts of the best brains of the world for many years. So it isn't for me to say just what required ingenuity and what didn't, after the thing is twelve years or more old.

Q. You would consider then that it requires ingenuity of a leading brain? A. Oh, I am not making any statement one way or the other; I don't see why I should. I wouldn't like to undertake to answer all such questions as of twelve years or more ago, however.

Q. You had experience twelve years ago in permanent mold practice? A. Yes.

Q. And you knew it was as common as could be to provide fillets for outer parts in molds? A. I knew it was necessary to provide either a structure which is simple enough to be molded or a mold which is complicated enough to take care of a complicated structure.

Q. And if the thing would overhang, you couldn't get it out; you would just be helpless? A. No, I don't take that position, either, Mr. Bruninga. I simply don't care to pick these things which produced results which engineers long sought, try to pick them to pieces and destroy them by calling attention to the things which may now look simple and easy, that is all.

Q. You would say then from what I previously read from the patent and what you understand this patent is, it contemplated a continuous skirt if properly relieved? A. Well, I didn't say that it contemplated that necessarily; but it may include it, I don't know. It includes some features of it, at any rate. Apparently this Jardine disclosure is the first real construction which showed how to produce a single walled piston made of aluminum alloy which could be given a sufficiently small clearance at the upper end of the skirt to eliminate slap and yet have sufficient clearance to operate when the motor is hot. That is a very broad statement and that is what I conceive to be the Jardine disclosure.

Q. By a "single wall" do you mean something you could readily get the cores and molds away from? A. No, I mean a single wall, and I mean just that. The Gulick construction is shown as a double wall, and this Spillman & Mooers is a double wall construction, and the Ray Day is a double wall construction. It was shown how to get the flexibility in a double-walled construction, but I don't think it was shown how to get it in a single walled construction, prior to Jardine. I know it was a great relief to us, at any rate, when the Jardine piston was developed and it functioned as it did.

Q. Ray Day is a double-wall construction? A. In part, yes.

Q. But you still say it embodied the improvements of the Jardine patent? A. It embodies one of the elements, at any rate, of the Jardine patent.

Q. Then, as a matter of fact, the distinguishing feature of the Jardine patent cannot be that it is a single walled structure? A. Not of the Jardine patent as a whole; but the Jardine disclosure as shown in Figs. 6 and 7 I think can be.

Q. And you would say then Figs. 6 and 7 illustrate the improvements embodied in the Ray Day piston, Exhibits 8 and 9? A. Possibly one combination, that is the skirt which is both flexible and is relieved upon the bosses or the portions which receive the heat directly from the piston head.

Q. In a case of this kind, the old maxim applied that things which are equal to the same thing cannot be equal to each other? A. You can philosophize on that, if you please.

Q. Now, in your discussion of the Jardine patent, I believe you made this statement that the Jardine patent was simply the Gulick patent with the walls cut away, which I understand to be those walls outside of the webs.

A. No, I didn't at least mean to imply that it was simply that.

Q. Well, that is just about what Jardine amounts to, isn't that right? A. Jardine amounts to more than that.

Q. What more, would you say? A. In the double duty functions of the various parts of the piston which cooperate with one another to perform the many required functions of a piston and the utilization of a different mode of operation, or an added mode of operation from that of Gulick, as well as a rather marked simplification of structure and the lightening of the piston body.

Q. Well, Doctor, what is the difference, for instance, between the construction shown in sheet 1 of the Jardine patent, in which the webs are suspended directly from the head, and the Gulick patent construction as shown, for instance, in Figs. 1 and 2? A. (After examining same) With the exception of the web shape they would be to quite an extent similar.

Q. In other words, you cut out the outside skirt part outside of the web? A. Yes, that is true.

Q. If they are in the way, just cut them out; isn't that the proposition? A. If they are in the way? I don't know as that is the assumption, that they are in the way.

Q. They are in the way of casting with permanent molds? A. Well, perhaps the webs are in the way. That is what was previously thought, at any rate. Therefore take out the webs.

Q. There would only be two alternatives; take out the webs, or take out the skirt part? A. No, there were thousands of alternatives. After a thing like this is once developed and then you see the final results, you may bring them down to a few alternatives; but when people are trying to get these results and grapple in the dark, then there are thousands of alternatives.

Q. How do you know Jardine was trying to get these results? A. Because I had been connected with him in the same organization for several years prior to his achievement here.

Q. And he was struggling along on the solution of this problem? A. Yes, he was, as were many other people.

Q. But Jardine particularly was struggling? A. Yes, he was working hard on it.

Q. What caused the struggle to begin—was it Ricardo that Mr. Richey in his opening statement, or rather in his reply to my opening statement, referred to? A. No; the struggle began when the problem came with the excessive expansion of aluminum alloy pistons when operated in cast iron cylinders, and one only had to be connected with the piston business a few weeks to learn of that difficulty.

Q. The same difficulty today? A. It is still a difficulty, but it has been so successfully solved that millions of these pistons are in use and they are standard equipment on many cars on the street. They also are used on replacement in cars which are put out with cast iron pistons.

Q. Didn't you use the same language before Judge Faris and Judge Kerrigan in the mold cases?

Mr. Richey: I object to that as immaterial.

The Master: He may answer.

A. You were the one that contended, Mr. Bruninga, in those cases that it was the slotting of the skirt that solved the aluminum piston problem and made it a practical thing. I didn't so contend, although I never minimized the advantages of the slotted piston. The position there was very clear, that large numbers of pistons were made and sold and used without slits and slots and that those pistons were regarded as successful at the time. There was not the care taken in the removal of noises in those days that there has been during the last few years, but in so far as the position taken in the various cases, I think if you will read your opening statements and also your brief carefully, you will see that you were the one that claimed that it was the slotting of the skirt that made the aluminum piston successful.

Q. The expedient of slotting the skirt was the beginning of the automobile piston industry? A. It was the beginning.

Q. Isn't that what I said: that the beginning of the use of the expedient of slotting the skirt was the beginning of the automobile piston business as far as aluminum pistons are concerned? A. You mean you didn't use the

word "invention." I don't believe you used the word "invention," but you gave slotting of the skirt credit for making the aluminum piston industry.

Q. Did I say that all the credit was due to that or did I say that it was not until 1920 or 1921 that the piston really came to its own? A. No; you said that it was the slotting of the skirt that made the aluminum piston business successful.

Q. But you were very forceful in saying it was the permanent molding that made it successful; isn't that a fact? A. Yes, and it is. These ninety million pistons referred to by Mr. Whitney, and millions more, have been cast in permanent molds. That is essentially the aluminum piston industry and has been in the United States, that is, the permanent mold casting.

Q. And you were representing the Aluminum Company of America, one of the licensees in these suits, weren't you? A. Yes.

Q. When you stressed the permanent molding as being the solution of the problem? A. Yes.

Q. And you further stated that the same processes and molds were in use to-day and without any substantial changes? A. That is correct.

Q. And you didn't tell either Judge Faris or Judge Kerrigan that the splitting was the thing that made it successful? A. No, I did not, and it wasn't. Millions of pistons were made and sold before the splitting came in. I don't know how long the business would have lasted without the flexibility or how much it would be to-day. We certainly would have the aircraft business, probably, and a good deal of truck and bus business where noises aren't so important; but those are things I can't answer.

Q. Now, Mr. Richey mentioned a Mr. Ricardo in the reply to my opening statement, and he stated that the Aluminum Company of America had experimented with the Ricardo piston and found it a failure. A. That is correct.

Mr. Richey: Just a minute before you get that answer. My statement was in reply to my adversary's statement, and I object to the question as inquiring into the prior art on prima facie and as not having been named in direct examination.

The Master: Of course it has already been answered. The reply may stand and you may have your exception.

Q. Now, Mr. Jardine's efforts on the slipper piston, cumulating in the Jardine patent in suit, were the continuation of the experiments with the Ricardo piston, isn't that right?

Mr. Richey: I make the same objection.

The Master: Same ruling.

A. No, not necessarily. The Ricardo piston had been tested and had been found wanting; that is true; but I know for a fact that Mr. Jardine was working on all kinds of pistons at the time.

Q. Well, how many Jardine pistons have been sold; I mean the slipper type? A. I suspect none.

Q. And how many of Ricardo's did the Aluminum Company of America sell? A. None, as far as I know.

Q. Then the Jardine piston has never been on the market? A. I think not. It was proved in, however, and was about ready to be placed on the market when the Maynard piston was brought forth, and the Maynard piston was the one that went into large commercial use.

Q. But the Ricardo piston wasn't on the market? A. No.

Q. Never was on the market in this country? A. Not that I know of.

Q. Hupp didn't use it? A. Not that I know of.

Q. What was the matter with the Ricardo piston? A. It slapped when it was fitted loose enough so that it would not stick or seize. It seized when it was fitted close enough that it would not slap. And it pumped oil.

Q. And that oil pumping was prevented by the Maynard piston? A. The oil pumping was greatly improved, yes, by the Maynard construction, that is true.

Q. And you had oil pumping with the Jardine piston? A. Yes. The Jardine piston was not very satisfactory from the standpoint of oil consumption.

Q. What was the difference between the Jardine piston and the Ricardo piston that you experimented with?

Mr. Richey: I object to that for the same reason.

The Master: Oh, he may answer and you may have your exception. Don't take very much time on this though.

A. The Ricardo piston was really built too rigid. We not only had over in this country a Ricardo representative, a Major Halford, but we had an automotive

engineer who was supposed to know a good deal about the Ricardo, about the developments and so forth, and the piston which they supplied the Aluminum Company was one which was built for rigidity, not for flexibility. So that the Ricardo piston as it was known to us was of the head construction more like the Jardine, Figs. 2 and 3, and the webs were thick and fairly massive, the skirt portion or the slipper was also fairly thick, and it was drilled full of holes in order to lighten it; but the Ricardo piston was built essentially for rigidity, to get a rigid structure. While the piston in Jardine flexed in a lateral direction, Ricardo was rigid vertically and laterally. Jardine is rigid vertically but flexible laterally.

Q. The slippers of the Ricardo piston weren't split?

A. No, they were not.

Q. But as far as massiveness and material is concerned, the Ricardo piston was just about a picture of the first sheet of the Jardine patent structure? A. No; the Ricardo piston had much thicker walls all around, webs as well as skirt section.

Q. I don't mean as far as thickness of metal, but I mean a head with a couple of webs extending down, and wrist pin bosses carried by the webs, and slippers on the webs—that was the Ricardo piston? A. That is correct.

Q. And Jardine proceeded to split the slippers?

A. Well, he did more than that.

Q. Well, he did that, didn't he? A. He did that, yes.

Q. And Gulick also did that, split the skirt? A. Yes.

Q. Between two webs? A. Yes; Gulick did that.

Q. And Jardine made the second split; is that right? A. Yes.

Q. But he made it on both sides? A. Yes.

Q. Now, take up the Gulick patent 1,815,733, that piston has never gone into commercial use? A. I believe not.

Q. You have never seen one in use, have you? A. In commercial use, no, not in the construction as shown in the drawings.

Q. It is just a paper patent, then; or don't you know? A. No, I don't think it is a paper patent. I think that is the patent which describes the first successful piston with a flexing skirt.

Q. You think it is the first one to describe that? A. I think it is the first one that describes an operative structure with a flexible skirt for aluminum construction.

Q. But still although it was filed in the Patent Office over fifteen years ago, it has never gone into commercial use as far as you know? A. Not in the form in which it is shown in the figures in the patent.

Q. It doesn't say a word about being used as an aluminum piston, does it? A. No.

Q. Doctor, we have been talking about side thrust, whether it is due to expansion or contraction. The side thrust is due to the pressure operating on the wrist pin which on account of the angularity of the connecting rod forces the piston against the cylinder wall; isn't that right? A. That is correct.

Q. And that pressure is transmitted through the wrist pin; is that right? A. Yes.

Q. Now, if you took the Gulick patent structure, and I hand you a cross section of a piston which is not intended to be a piston but simply a model,—that is a fair representation of Figs. 1 to 4,—I don't mean as to details, because I don't intend to hold you down to details, but just for illustrative purposes? A. (No response.)

Q. Now, if a piston of this kind is put into a cylinder and pressure is applied to the head, whether due to compression or due to the action of the explosive gases, the pressure is transmitted from the head directly to the wrist pin; isn't that right? A. Yes.

Q. And it is transmitted then directly from the wrist pin through the side webs to the skirt; is that right? A. Yes.

Q. So the thrust on these webs is transversely, isn't it? The thrust from the wrist pin to the cylinder wall is along these webs? A. Yes.

Q. There is also a pressure on the skirt having a movement through the cylinder and resisted by friction, isn't that right? A. Yes.

Q. And that friction is due to the pressure on the cylinder wall, of the piston on the cylinder wall? A. Yes, and to the state of the oil.

Q. Now, which pressure would you say is the highest,—the thrust pressure or the pressure due to friction? In other words, where is the greatest pressure on that web, transversely on the line 4-4 or vertically on the web 18, for instance? A. I am a little confused here as to what you mean by the vertical friction.

Q. There are two pressures on this web: one is a thrust pressure along a line 4-4. You realize that, don't you? A. Yes.

Q. Operating from the piston, from the wrist pin against the skirt and through this web? A. Yes.

Q. That is one pressure? A. Yes.

Q. There is another pressure on the web due to the pressure of the gases on the piston operating through this web 18 and resisted by the friction of the skirt? A. Well, of course it is resisted infinitely more by the resistance of the crank shaft to rotation.

Q. I am trying to get the pressure on the web. These webs do nothing but carry the skirt; isn't that right; these webs 17 and 18? A. Oh, they carry the skirt and they carry the wrist pin and they flex; they have quite a number of functions.

Q. Yes. But I mean as far as their doing any work is concerned, the side webs on the side of the wrist pin, the top part is the one that transmits pressure from the exploded gases to the wrist pin; isn't that right? A. Yes.

Q. And these webs really only carry the skirt, to function? A. That is one of the functions of the webs, yes.

Q. Now, the transverse pressure along the webs, along the line 4-4, that is the greatest pressure, isn't it, as compared with the pressure along the webs resisted by the friction of the piston in the cylinder? A. I should think so, yes.

Q. So therefore, if you want rigidity, you have to have rigidity crosswise of the piston and lengthwise of these webs 18; that determines your rigidity? A. Yes, to quite an extent that is true.

Q. And the thickness of these webs is determined by the thrust force due to the explosion? A. Oh, no, the thickness of those webs could be very much less and still stand the thrust force.

Q. I am not referring to any particular size web, but the thickness of those webs is determined by the thrust forces, isn't that right? A. In, I think, only minor parts.

Q. What determines the thickness of those webs? A. Well, the desirability for lateral flexibility in this case.

Q. Well, what determines the maximum thickness? I am not talking about minimum thickness; what determines the maximum thickness? A. Well, I think its flexibility determines the maximum thickness.

Q. In other words, you don't want it too flexible?

A. I should think the question would be put just the other way.

Q. You want it just as flexible as you can? A. You want the right degree of flexibility.

Q. Is there such a thing as too much flexibility? A. Yes.

Q. What happens then? A. Well, the piston moves too easily in response to cylinder wall pressure.

Q. Do you think there is ever any trouble about that, if you make these webs thick enough so they can stand the thrust? A. Oh, I think the whole thing has to be designed with the object of gaining the mode of operation and results contemplated.

Q. The original specification of the Gulick application read as follows: referring to page 2, lines 10 *et seq.* of the patent—I am just going to read that paragraph, read you the original specification, and I would like to ask you some questions: “It will be seen that in addition to providing a piston with a split skirt the above described construction also provides an extremely rigid connection between the piston pin bosses and the skirt of the piston which construction may be used either with or without the split skirt and separated head.” Now, when it describes “an extremely rigid connection” it must have had reference to webs 18 going radially from the piston pin bosses and the skirt? A. Yes.

Q. The specification now reads: “It will be seen that in addition to providing a piston with a split guide portion, the above described construction also provides a longitudinally rigid connection between the piston pin bosses and guide portion of the piston which construction may be used either with or without the split guide portion and separated head.” It now refers to a longitudinally rigid connection. The longitudinally rigid connection is this connection (indicating)? A. No, it means it is rigid in a longitudinal direction, up and down.

Q. Rigid up and down? A. Yes.

Q. But not rigid cross-wise? A. Well, it might be rigid cross-wise in one direction, but not at a direction at right angles to that.

Q. But reading it without that careful word “longitudinally” when it states “also provides an extremely rigid connection between the piston pin bosses and the skirt of the piston,” one would naturally assume that the “extremely rigid connection between the piston

pin bosses and the skirt of the piston," is this web or connection right here about at 16, Fig. 1; isn't that right? A. It would have to be in the connection between the boss portion and the skirt portion. But then so far as rigidity is concerned, that is of course incompatible with flexibility. He does have a rigid piston longitudinally, and a flexible piston laterally.

Q. Well, why must he have a rigid skirt longitudinally when the pressure is all lateral? A. The pressure isn't all lateral.

Q. Where is the pressure longitudinally on the skirt of a piston constructed like this with the skirt separated from the head and the head connected directly to the wrist pin bosses? A. The skirt of course must not move up and down as the piston moves up and down; that is, it must not move up and down relative to the other parts of the piston.

Q. But you have just admitted, Doctor Jeffries, a little while ago, that the side pressure was of much greater magnitude than the vertical friction pressure, you might say. Resistance cross-wise would be greater than resistance lengthwise, as far as this skirt is concerned, which has nothing connected to the piston and does not have any explosive strains on it at all. A. Well, you asked me only with reference to the explosion stroke, and with the exhaust stroke the thing is reversed.

Q. Well, suppose it is, what pressure is there on these webs? A. In the exhaust stroke, when the piston is moving upward, it is moving against practically no pressure; in the last half of the piston travel, it is really pulling up against the wrist pin, and it is the lower part of the webs that would take that stress.

Q. What stress—on a vacuum, or something like that? A. No; the inertia stresses of the piston.

Q. You think the inertia stresses are greater than the thrust stresses? A. At that particular time they certainly are.

Q. At that particular time they are greater than the thrust at that particular time? A. Yes; and possibly greater than the thrust at any time; I don't know. May I ask if these original drawings accompanied the original specification?

Q. Oh, yes. A. Well, then, it is clear enough what he had in mind. These drawings are susceptible of no other interpretation, as I see it. You have got longitudinal rigidity and lateral flexibility.

Q. You also have lateral rigidity, haven't you, along the webs? A. Along two lines, yes.

Q. And the way you would have read that before it was carefully amended, that instead of "extremely rigid," "very flexible"? A. No, I wouldn't be confused as to the description if I had the drawings before me.

Q. But you don't think for one moment that the expressions "extremely rigid" and "very flexible" are the same expression? A. They are not the same expression.

Q. But there must be, in a piston of this kind, rigidity along the webs during the thrust stroke, I mean during the time that the thrust is acting? A. Very little; that force is very small.

Q. Very small? A. Yes.

Q. Don't even wear the piston, does it? A. Yes, it wears the piston, especially if the oiling is not what it should be; but it doesn't take great pressure to produce wear on two metal surfaces.

Q. The thrust against the cylinder wall, you might say, is negligible? A. No, I don't say it is negligible.

(Short recess taken.)

Q. Are you familiar with the design of automobile pistons as far as strength of materials is concerned, Doctor? A. I am not familiar with the magnitude of the stresses encountered mathematically, no.

Q. You are not really able then to answer questions as to what relative forces are encountered and the building of a structure to meet those forces? A. No, not from the material strength and mathematics of it, I am not.

Q. You may be able to answer this question: if not, say so. What I want to know is what determines the thickness of these ribs, the transverse stress due to the thrust, the stress along these ribs now, or the vertical stress along these ribs due to the inertia on account of change in direction, keeping in mind now that this skirt is entirely separated from the head in this Gulick piston. A. Well, I don't see how you can separate one from the other. That is, your finished piston design is supposed to take care of all the stresses and do all the functions that are required of the piston.

Q. But the stresses set up in these webs due to reciprocation are more shearing stresses, aren't they? A. In the webs, yes.

Q. In those webs? A. Yes, I think that is true.

Q. And the stresses due to the angularity of the connecting rod and the thrust are bending stresses, are they not? A. Yes, they are bending stresses and column stresses.

Q. Would you not say then, Doctor, that the thickness of the web is really determined by the stresses due to the thrust? A. Well, that may be one of the factors.

Q. Well, wouldn't you say that is the determining factor? In the design of machinery you have certain determining stresses, and you can just eliminate all the others in some problems? A. No, I wouldn't say that. This piston is made, among other things, to flex, so the flexibility factors have to be given consideration.

Q. Well, let's assume that it is made to flex. I haven't undertaken to dispute you on that point at all. But let's determine what determines the thickness of these webs, the thrust, stresses due to thrust, or the stresses due to restriction, that is shear stress? A. Oh, I think perhaps the thrust forces would determine more the thickness, because if they were very thin they certainly would have a tendency to bend.

Q. Then the thickness of the web would be determined by the thrust? A. No, I told you the thickness is a complicated thing, and must depend on all the functions required of the piston.

Q. Flexibility and everything else? A. Yes.

Q. Now, as far as flexibility is concerned, the rigidity, extreme rigidity, has nothing to do with that, has it? In other words, the more rigid you make it in order to take up the thrust, the less flexible it will be? A. Generally speaking, the more rigid you make it laterally the less the lateral flexibility.

Q. And if I make the statement that there should be an "extremely rigid connection between the wrist pin bosses and the skirt," I mean rigid enough to take up the stresses or to take care of the stresses due to the thrust? A. To a large extent, yes.

Q. Now, that may be sufficient to permit flexibility; we haven't come to that at all; but when a man talks about it being "extremely rigid," "an extremely rigid connection between the wrist pin bosses and the skirt," he means rigidity in this transverse connection along the rib, doesn't he? A. Yes, I think that is true.

Q. You don't know what the thrust is in an ordinary automobile engine? A. No.

Q. Now, the split in this Gulick piston is on a bias, and that is also true of all these pistons before you. You

know why that is, don't you? A. Yes; it is stated, I think, in the, if not in the Gulick patent, in some of the others, that that feature of the split is for the purpose of helping to wipe oil on the cylinder wall, in order not to cut a groove up and down in the cylinder barrel.

Q. If it was a straight up and down slit, it would finally wear a ridge or groove, or whatever it is, right in the cylinder? A. It might do that.

Q. That is what they believed, anyway? A. That is what has been suggested, at any rate.

Q. That is quite an old expedient, isn't it? A. In this connection?

Q. Well, all piston rings are split on the bias, are they not? A. Well, that is quite a different operation.

Q. But they are split on a bias, and have been ever since 1915 when you first took up with pistons? A. I think so; that is true.

Q. Now, the opening in the skirt of the Gulick patent, 24, is really for the purpose of permitting insertion of the wrist pin; isn't that right? A. Yes.

Q. And that is described in the specification as follows, page 1, lines 98, *et seq.*: "The skirt 11 is formed with openings 24 in its side registering with the openings through the bosses 16 so that the piston pin may be inserted." The specification then continues, and I will later on show that was added by amendment: "As these openings are well above the bottom of the guide portion of the piston, the lower end of the piston skirt is left unbroken except for the split 21, and the arcuate parts of the skirt beneath said openings may be looked upon as joining the lower ends of the diametrically opposite cylinder-engaging parts of the guide that sustain the angular thrust of the connecting rod." That descriptive matter would also apply to this Spillman & Mooers patent structure, wouldn't it, leaving out the split?

Mr. Richey: I object; inquiring about the prior art.

The Master: 'Same' ruling. This Spillman & Mooers was referred to by the plaintiffs, was referred to in one of these patents in suit, and I think it is proper cross examination.

A. That is correct, I think.

Q. So that there is nothing really new or novel added by that statement? A. I don't know.

Q. Well, if it was shown in the Spillman & Mooers patent it couldn't be new and novel, that statement as to

the function, leaving an unbroken part below the skirt and so forth? A. (No response.)

Q. The patent specification also states that the web structure may be used without the skirt; is that your understanding that it may be so used, and still attain some of the advantages of the Gulick patent structure? A. You said without the skirt?

Q. Without the split. A. I think it is so suggested in the specification, yes.

Q. Now, when we come to, let's take up the matter of yielding. That skirt of the Gulick patent is split. It doesn't tell you the magnitude of the split, but it shows a separation at 21. Now, what happens when the piston heats up, after it is fitted to a cylinder and fit fairly close when cold? A. The skirt section would normally expand and the head section of course would expand also to a certain extent.

Q. And the skirt section would finally expand and the slot would close or tend to close? A. That is correct.

Q. Do you know, in practice, just how much closing actually takes place, for instance, in the piston such as shown here, the Ford piston in which the slot is about $1/16$ " wide? A. I think usually a closing of a very few thousandths of an inch is all that is required.

Q. Would you say about half of that sixteenth is all that is required? A. A half of the sixteenth of an inch?

Q. Yes; a thirty-second of an inch? A. Oh, that would be much more than is required in practice.

Q. In fact, a thirty-second of an inch is .003; isn't that right, approximately three thousandths? A. Approximately thirty thousandths.

Q. Approximately thirty thousandths. Now, how much flexing of the webs would take place with a closure of, for instance, thirty thousandths? A. Very considerable. I don't know actually how much.

Q. Well, it wouldn't be over half of that amount? A. It would be perhaps less than that, because the skirt would also flex some.

Q. But your position is that from those drawings the inherent structure is such that these webs 17 and 18 would flex? A. Yes.

Q. Could you make them any way so they would not flex? A. Yes.

Q. I am not adverting to that structure, but make these an inch thick, the webs an inch thick. A. Oh, if

they are made an inch thick, you haven't a practical piston at all.

Q. Well, do you think that the webs would flex to permit closing of the slot? A. Not perceptibly, no.

Q. There is a certain limit that you could go to. Do you know what that limit is in the Gulick piston? A. No.

Q. You haven't made any experiments of that? A. No, not to determine web thickness.

Q. You would consider the patent drawing, if that shows webs of about the right size that will flex? A. Yes.

Q. It is your opinion they would flex? A. Yes.

Q. How did you find that out,—by experiment or theoretical determination? A. By experiment. I have here a Gulick piston which appears to be also made very closely to the drawings of the Gulick patent, corresponding to the Figs. 1 and 2 construction.

Q. Except that the head is not concave? A. No, the head is not concave.

Q. You don't consider that that makes any difference? A. Not materially.

Q. What size piston is this for; what kind of car—for an Oakland, isn't it? A. Yes, I think it is.

Q. It is about the size of a motorcycle cylinder? A. It is a commercial size piston.

Q. Who made that piston? A. I don't know.

Q. Where did you get it? A. From Mr. McCoy.

Q. It is a very small piston, isn't it? A. Yes, it is a small piston.

Q. And you tested that out? A. I tested this with respect to its flexibility.

Q. And it is flexible? A. Yes.

Q. The clearance allowed on pistons is a certain amount per inch in diameter; is that right? A. Yes.

Q. And the smaller the diameter the smaller the clearance? A. That is correct.

Q. The smaller the diameter the smaller the expansion? A. Yes.

Q. And the smaller the flexure required? A. Yes.

Q. So the flexure on that is about as small as you could possibly make it; is that right, in commercial use today? A. No.

Q. Do you know any smaller piston than that? A. Well, the flexing is not merely a matter of size; it is also a matter of construction. I know of smaller pistons than this.

Q. What piston is smaller than that? A. Motorcycle pistons.

Q. Have you any particular one in mind? A. No, I haven't any particular one in mind at the moment.

Q. Are these motorcycle pistons split at all in practice? A. I think they are.

Q. Do you know whether they are? A. No, I am not sure.

Q. Do you know of any motorcycle pistons that are not split at all? A. No.

Mr. Richey: I will offer that Gulick piston in evidence as Plaintiffs' Exhibit 20.

Q. Are you familiar with the Excelsior motorcycle? A. No.

Q. You know of it, don't you? A. No, I don't.

Q. Would you say, then, Doctor, that in order to secure flexibility, flexible webs, flexure of webs in a structure like the Gulick patent, that the webs 17 and 18 would have to be a certain minimum thickness for any piston diameter? A. With a definite skirt thickness, yes, and also with a definite vertical height of web that would also be true. That is, considering Fig. 1 of the Gulick patent, if the height of the web from a position near the line 4-4 vertically downward or angularly downward towards the figure 17 were made less, then the flexibility of the web would be greater. So that the flexibility is not merely the function of the web thickness, but it is a function of the height of the web. The stiffness does, however, vary as the cube of the thickness, and merely as the first power of the height.

Q. But you have to be pretty definite in your design in order to secure sufficient flexibility to permit closing the slot or partial closing of the slot to compensate for expansion in a structure like in the Gulick patent? A. Well, it certainly could be made so that it would not flex enough, and it could be made so that it would flex too much. It happens, or it is a fact that the Gulick construction appears to flex a proper amount.

Q. You wouldn't say then that the inherent flexibility of any structure having cross webs is then sufficient to permit a skirt to contract circumferentially in order to compensate for expansion? A. No, I would not. This contraction is not a circumferential contraction in the sense that the entire circumference is contracted. It is a reduction of diameter by the closing of this slot, by the general cantilever principle.

Q. Will you explain how that cantilever principle works? A. Well, in the Gulick construction, the whole of the skirt is permitted to move from top to bottom by virtue of the complete horizontal slot as shown in Figs. 1 and 2; it is permitted to move throughout its length by virtue of the vertical slot 21. When the pressure is applied, the part of the piston just opposite from the side which is slotted, in that case it would be the part in front of the diagram in Fig. 2, that portion would serve as the fixed end of the cantilever, and the portions at the slot would represent the movable ends of the cantilever. So that the beam length would be equivalent to the diameter of the piston in that particular case. So that represents what might be called the cantilever principle of flexing.

Q. That is, flexing due to pressure on the cylinder walls; is that right, due to thrust? A. Yes; due to thrust or due to expansion.

Q. Now, as far as expansion is concerned, when that piston skirt of the Gulick patent heats up, there is a growth circumferentially, too, isn't there? A. Yes.

Q. And where is that growth taken care of, for instance, in this region opposite the wrist pin bosses and between the ends of the webs? A. Well, it is taken care of by the clearance and also if necessary by the deflection of the whole skirt.

Q. When this part, indicating around 24, begins to grow on account of the increase in temperature, is it your position that the web 17 flexes in order to permit that growth, or that the webs will heat up at the same rate or greater rate? A. Well, I can't say they heat at a greater rate or they heat at a lesser rate, but at any rate the two parts heat up together, and to that extent they balance one another.

Q. In a structure of that kind it is no small job to design, to get the right thickness and to get the right flexures; is that right? A. You mean now?

Q. Well, in 1917? A. Why, I should think it would have been quite a task.

Q. Even a means of designing, the proportioning of the materials after the structure was delineated in the drawing generally? A. You might have to do some experimenting to get just the right combination of flexing and rigidity desired for that particular structure.

Q. The Jardine patent goes quite a length, doesn't it, on page 2, in stating that the webs should be properly proportioned to permit that flexing? A. Yes.

Q. And the Gulick patent doesn't say one word about it, does it? A. He states that the structure should flex in response to cylinder wall pressure.

Q. He does in the patent as it stands now to some extent, but in the absence of any statement of that kind that the webs do flex, what have you to say then? Do you think the disclosure is sufficient just from the drawing to delineate that which Mr. Jardine found necessary to state quite in detail? A. It is not a treatise telling one how to design any particular piston, as I see it; but the principle of the compensation for excessive expansion by flexing by means of horizontal and vertical slots is clearly covered in the Gulick disclosure.

Q. Well, I am asking now about the drawings. You can read drawings, and to your mind they give you a complete picture, don't they? A. Fairly complete, yes.

Q. And those drawings, with the simple statement that the piston is made to take care of expansion, that would be enough to give you the idea that the webs should be properly proportioned to flex? A. I think so.

Q. Due to the inherent structure? A. Yes.

Q. And if you found out from the drawings themselves that the webs weren't of the right thickness, you would just sit down and make them the right thickness, wouldn't you, in designing them? A. Why, I think if I tried this out and found it didn't work, I might be suspicious of the description and mode of operation or something of that sort; I don't know what might happen.

Q. In other words, you would give up right away if the Patent Office drawings wouldn't give you an operative structure? A. Not necessarily.

Q. You wouldn't try any different thickness webs at all to see if that would give you too much or too little flexibility? A. Oh, I don't know what I would do under the circumstances.

Q. You can't even tell me as an engineer skilled in this art? A. No. When you have a thousand possibilities or even twenty possibilities, it is difficult to say just how far a person would follow one or the other up.

Q. Now, comparing the Gulick patent structure with that of the Sterling type piston and taking up first the connection from the head to the skirt, in the Gulick patent structure the head and skirt are separated entirely, aren't they? A. Yes.

Q. That is not by any means true of the Sterling type? A. No, that is true.

Q. Of the Sterling type, Exhibit 1, for instance? A. That may not be clear. The connection between the head and skirt is structurally different in Plaintiffs' Exhibit 17 from that shown in the Gulick drawings.

Q. The mode of operation is also somewhat different, isn't it? A. Plaintiffs' Exhibit 17 embodies as one of the elements of the combination the flexing mode of operation disclosed in Gulick.

Q. Only at the bottom; isn't that right?

Mr. Richey: I think he has got the plaintiffs' piston, and you asked about the defendants'. Is that what you want to do?

Mr. Brumling: They look—

Mr. Richey: All right. Same pistons.

Q. What have you? No. 1 or 17? A. I have Plaintiffs' Exhibit 17.

Q. Well, take Exhibit 1, because that is what we particularly referred to. A. In Plaintiffs' Exhibit 1 when the slot is completed, it involves as one of the elements of the combination the flexing as the result of a horizontal and a longitudinal slot at both top and bottom of the skirt and at all points between.

Q. Well, Exhibit 1 really flexes only at the bottom, doesn't it? A. No. I showed you this morning that it flexes at the top as well, and furthermore I stated that unless the slot is completed at the top of the skirt, that is, unless the vertical slot joins the horizontal slot, the piston is not successful for use.

Q. Well, you showed me by applying a pressure many times that encountered in an automobile engine. A. Yes, but I showed you many times the deflection that is required to compensate for the excessive expansion also.

Q. The Gulick patent structure doesn't have the keystone relief, does it? A. No.

Q. There must be some reason for that. A. Yes.

Q. Is the Gulick patent structure inoperative because it doesn't have the keystone relief? A. No; the Gulick patent structure is operative because it has great flexibility at the top of the skirt as well as at the bottom of the skirt.

Q. And defendants' infringing piston structure only has great flexibility at the bottom? A. The defendants' structure, as shown in Plaintiffs' Exhibit 1, has greater flexibility at the bottom of the skirt than at the top of the skirt.

Q. In defendants' piston structure the wrist pin bosses are inside of the skirt outline; isn't that right?

A. Yes.

Q. And that is not true of the Gulick patent, the skirt extends around? A. Yes, that is correct.

Q. In the Gulick patent structure the wrist pin bosses are suspended from the head itself, are they not?

A. Yes.

Q. And in defendants' they are really on the skirt, are they not? A. They are in a web which attaches to the skirt and to the bottom of the ring flange.

Q. Well, you call that a single walled structure; that means they are on the wall of the wall structure? A. They are on the wall structure, yes, that is true.

Q. Now, in the Gulick patent structure the skirt is really independent of the head, and entirely disconnected? A. At the top, yes.

Q. And in defendants' it is really a part of the head, the skirt, is it not? A. It is hardly a part of the head; it is integral with the ring flange on two sides above the bosses.

Q. Well, defendants' Sterling piston is really a trunk piston with a T-slot, is it not? A. No, I wouldn't call it that.

Q. Well, it has its sides depressed so that part of the wrist pin bosses are on the outside of the skirt? A. The defendants' piston, as mentioned a number of times before, embodies a number of elements of construction designed to cooperate with one another and to perform all the essential functions of the piston and in addition take care of the excess of expansion as the result of the use of aluminum in a cast iron cylinder.

Q. Will you please answer that yes or no? A. I don't know what you mean.

Q. Don't you understand that question? A. Yes; but I don't know of any trunk piston that answers that description.

Q. Isn't that exactly what defendants' piston is,—a trunk piston with a T-slot and the sides depressed so that the wrist pin bosses will be partly outside of the depressed part of the skirt? A. Well, that might describe some of the features of the defendants' piston, but taking for example the trunk cast iron piston, Defendants' Exhibit 3-H, I see no part of the boss in such a piston outside of the skirt.

Q. I didn't ask you that. I asked you whether that is not what you obtain as a result, a trunk piston with

its sides depressed so that the wrist pin bosses are outside of the depressed part, extend outside of the depressed part, and with the T-slot? A. I think, if you wish to have this described as a modified trunk piston, we should perhaps get all of the modifications.

Q. Oh, no, you don't have to answer then. Now, comparing the Gulick piston structure with the Spillman & Mooers patent, using the two halves, in both cases you have the wrist pin bosses or a structure carrying the wrist pin bosses, leading directly from the head, haven't you? A. Yes.

Q. In both cases, the structure leading from the head and which is in two halves, carries the wrist pin bosses? A. Yes.

Q. In both cases you have holes opposite these wrist pin bosses in the skirt, haven't you? A. Yes.

Q. In both cases the wrist pin carrying structure leading from the head is then connected to the skirt? A. Yes, in different ways.

Q. I expected you to say that. Now, I want to call your attention to the fact that the difference is that the connection is simply along the skirt in the Gulick, while it is over at the extreme bottom or a little bit above the bottom in the Spillman & Mooers; that is the difference, isn't it? A. Well, the difference is that the Gulick is connected longitudinally, and the Spillman & Mooers is connected circumferentially.

Q. Spillman & Mooers is connected circumferentially because the connection extends around the bottom instead of along the piston itself? A. Yes, the connection on Spillman & Mooers is entirely in a horizontal plane, whereas the connection in Gulick is on two vertical planes.

Q. You consider that a great distinction? A. Well, it is a difference in structure and also has in it the elements for different modes of operation.

Q. And that is a characteristic feature of the Gulick structure, that the connection leading from the head to the skirt extends along the piston? A. That is the structure that is shown in the Gulick drawing and in the section which you have before you.

Q. But that is a distinction between the two structures; isn't that right? A. I should say so in the typical structures of both patents.

Q. And you say that is an important distinction between them? A. It is in so far as the flexibility is con-

cerned in one case as in the case of Gulick, and perhaps with reference to the mode of operation of both structures.

Q. You wouldn't say it was an essential distinction, would you? A. Well, it seems fairly distinctive to me.

Q. But it is not in the Ray Day piston, which you contend is within the Gulick patent? A. No, it is not.

Q. In fact, the distinction between Ray Day and Gulick is about as much of a distinction as between anything you can think of? A. No; the Ray Day piston has the Gulick mode of operation and result. It also has the same web construction at the top, but it does have differences in construction from the Gulick construction shown in the drawings. It has the boss, for example, mounted partly in the skirt and partly in the web; but the mounting of the boss to the skirt forms the connection between the upper part of the piston and the lower part of the piston in Ray Day. And the webs in Ray Day flex just the same as the webs in Gulick flex; and the Ray Day piston is slotted horizontally the same as Gulick, and it is slotted vertically the same as Gulick; it operates like Gulick.

Q. And it is slotted horizontally the same as Spillman & Mooers? A. It is slotted horizontally the same as Spillman & Mooers.

Q. But Spillman & Mooers is not slotted vertically? A. Spillman & Mooers is not slotted vertically, no.

Q. And that is one of the distinctions which you want to point out now between Spillman & Mooers and the Gulick; that it is not slotted vertically? A. That is one distinction.

Q. You don't know, of course, that the Patent Office told Gulick that was not a patentable distinction?

Mr. Richey: I object to that as being immaterial.

A. No, I didn't know that.

Q. Then it is not so important as a distinction and characteristic feature, if you consider Ray Day comes within this Gulick patent, that in Gulick the connection is along the skirt, and in Spillman & Mooers it is at the bottom; that is not such an important distinction, is it?

Mr. Richey: Haven't we been over it two or three times? I object to it as immaterial.

The Master: He may answer. Just shorten it up, though.

A. It perhaps does not embody the latitude or breadth to which Gulick may be entitled or which the Patent Office considered Gulick was entitled to, in so far as specific construction is concerned.

Q. But you will have to admit that these two models look deceptively alike, don't they; the one in the Gulick patent and the other in the Spillman & Mooers patent?

A. No, I shouldn't say that they did when one makes the web connection through practically the entire length of the piston and the other merely on one cross section.

Q. Doctor, would you say that on account of this wee little rib along here that the real connection between the web and the skirt goes beyond the point about even with the center line of the skirt? A. Well, it does in that construction.

Q. It does in that construction? A. Yes, and it does in the drawing.

Q. You think this small amount is sufficient for you to say that the web extends up to the top of the skirt? A. Yes, I think so.

Q. And that is not so in the Spillman & Mooers because there doesn't happen to be a little teeny web along there? A. No; the distinction is quite different.

Q. But at least there is an inside wall there that extends from the connection to the top of the skirt somewhere? A. There is the skirt itself.

Q. It would be just a matter of making the wall thicker, isn't that right? A. Just a matter of changing it.

Q. Just a matter of making the wall thicker at that point? A. Just a matter of changing it from a horizontal connection to a vertical connection.

Q. You would say then that web extends to the top of the skirt? A. Yes, it does.

Q. And there is flexing in this air part here, that is out in the air? A. Flexing of the air—it doesn't sound like a reasonable question to me; I don't know how you mean it.

Q. You say the web itself extends to the top of the skirt. A. The web connection to the skirt, yes.

Q. Then there is flexing of the web? A. There is flexing of the entire web, yes.

Q. The entire length of the skirt? A. The entire length of the skirt.

Q. There is flexing of this web the entire length of the skirt? A. Flexing of the web the entire length of the skirt.

Q. And part of it is in the air, like the air groove of the Maynard patent? A. Oh, I think not. I think it is clear enough what the mode of operation is.

Q. I just wanted your view of it, what it was. Now, the Spillman & Mooers patent doesn't show a split, does it? A. No.

Q. And you demonstrated to your own satisfaction, I believe this forenoon, that the structure was weak on account of the fact that you could press this model, press the edge of the Spillman & Mooers model skirt in at the top? A. That is only one reason why I said that.

Q. That is due to the fact that this is a half section; isn't that right? A. That is only partly due to that.

Q. Well, I want to show you a full piston, Doctor, and see whether you still adhere to that opinion, marked for identification as Defendants' Exhibit 3-P.

Mr. Richey: I object to it. In the first place it is not the Spillman & Mooers patent or piston.

Mr. Bruninga: A slit has been made in that piston between the wrist pin bosses and it is different to that extent. I think I am fully justified in that because, as I will show later on, the Patent Office told Gulick's attorney distinctly that no patents would be granted on the splitting of Spillman & Mooers' skirt.

Mr. Richey: By his own admission he admits it is not the Spillman & Mooers patent structure; therefore it is not part of the prior art; no charge of infringement; nothing to do with the case.

The Master: He may answer and you may have your exception.

A. Yes, I can feel the flexing even in the solid side with the pressure of my own two hands.

Q. What would you do to stop that flexing? A. I don't know.

Q. You can't conceive of a thing? A. (No response.)

Q. I can also flex this Gulick patent structure, can't I, the half section? A. I suppose so; it is made to flex. I can flex it inwardly.

Q. Well, what is the objection then to the top of the skirt flexing in the Spillman & Mooers structure Exhibit 3-P? A. Well, the objection which I suggested is briefly this: this Spillman & Mooers construction has the head separated from the skirt, and the connection is

nearly down to the bottom of the skirt on a horizontal plane. Now, as the piston is forced against the cylinder wall, that force comes from the piston head, transmitted to the wrist pin, which in turn transmits the force to the cylinder wall. There is a tendency therefore for the head of the piston to move in a direction perpendicular to the axis of the wrist pin, and for the head section then to be thrown from one side towards the other side of the cylinder barrel. That tendency is evident from the flexing of the top of the skirt with reference to the bottom of the ring flange. What I said was that the head would have to be machined more closely to the size of the cylinder barrel to avoid too much movement of the head in that direction.

Mr. Richey: I object to that part of the question, and the answer, both, which refer to this thing here, Exhibit 3-P, as a Spillman & Mooers construction.

The Master: The same ruling.

Q. You don't know whether such thing can happen with the Gulick type piston; is that right? A. Well, the Gulick piston has this vertical connection of the webs which carry the bosses, so that the portion of the skirt adjacent to the ring flange is not left unsupported on the thrust faces to be moved with a long lever arm such as in the Spillman & Mooers construction.

Q. And that result is obtained in the Gulick patent by extending the web along, as you said, from near the bottom to the top of the skirt; is that right? A. No; it is obtained by having the boss connected to the skirt higher up on the piston, at any rate.

Q. And that structure is not in the Ray Day piston? A. That structure is partly in the Ray Day piston, and because the web is attached to the skirt at the bosses, not far below the bosses.

Q. In other words, the distinguishing feature in that respect between Gulick and Spillman & Mooers, is not in the Ray Day piston? A. Yes, it is present in the Ray Day piston to an extent, but not to as great an extent as in the construction shown in the Gulick patent.

Q. You mean the result is present in the structure? A. I mean the result is present, and an equivalent or a partially equivalent structure, at any rate.

Q. And in the Sterling piston structure, that is in the Sterling type piston, the Plaintiffs' Exhibit 1, there

is again a different structure, isn't there? A. A. Yes, there is a different structure.

Q. But now, considering this split Spillman & Mooers piston, the flexibility is very nice at the top; it is very springy at the top, isn't it? A. It is quite springy, yes.

Q. The maximum flexibility is really at the top of that skirt, isn't it? A. Yes.

Q. And the minimum flexibility is at the bottom? A. The minimum flexibility would be right at the junction of the web with the skirt.

Q. You wouldn't say this is incapable of flexing? A. No; I wouldn't say it is incapable of flexing.

Q. You would think that even at the bottom, the structure at the bottom is not such as to prevent compensation for expansion? A. I would say it is practically so.

Q. To prevent expansion? A. To prevent expansion by normal cylinder wall—to prevent contraction by normal cylinder wall pressure.

Q. You consider yourself as having a stronger grip than I? A. I don't know.

Q. I am able to use this tool, Exhibit 3-I, to flex the bottom of that skirt, am I not? A. Yes.

Q. And try it yourself and see if you can flex it much easier than you could Exhibit 17. A. Well, it is easily flexed with this device at any rate. And it would be a mere matter of quantitative measurement.

Q. But easier than the top of Exhibit 17 that you had to mar? A. I should say not, but I would want to reserve judgment on that, if there is any point in determining it.

Q. You wouldn't say then, Doctor, that the Spillman & Mooers patent structure that is split between the wrist pin bosses, is incapable of sufficient flexure or yield so as to permit partial closing of the slot sufficient to compensate for expansion? A. Yes, I think it would be quite impracticable. You see there is no other means provided in this case to compensate for such expansion, and if one depended entirely on that springiness, it is entirely too difficult to flex.

Q. But it can be flexed, can it not? A. Oh, yes, one can flex a steel rail.

Q. And if you put it in a cylinder and subject it to temperature conditions, it will flex, will it not, in your opinion? A. It will flex a very small amount in response

to wall pressures, and then I feel certain that it would cause seizure unless you finished the bottom of the skirt so that it would function without any slot in it at all.

Q. Have you tried it out? A. No, I haven't tried this out, but I have tried many pistons as to degree of flexibility.

Q. But you have never built the Spillman & Mooers structure as shown in the Spillman & Mooers patent and tried to split the skirt and tried it out? A. No, I haven't.

Q. And you have never seen it done? A. No, I haven't.

Q. You don't know of any one who has done it? A. No.

Q. Don't you consider it rather strange, with the issue as we have it today, that that wasn't done? A. No.

Q. You weren't asked to do it? A. No. This piston, even if it were made would be entirely impracticable, double-walled heavy structure; it means nothing in the art as far as I can see.

Mr. Richey: You mean even if it were split?

The Witness: Even if it were split.

Q. And that is all founded upon your opinion and not upon any experiments whatsoever? A. That is founded on about seventeen years of experience in the aluminum piston business.

(Thereupon adjournment taken to the following day.)

(9:30 A. M., Saturday, January 21, 1933, the hearing was resumed.)

Q. In this split piston, that is in which the skirt is split longitudinally, it is particularly desirable to have good flexure at the top, isn't it? A. Yes, unless the expansion is compensated for by other means.

Q. It is not so necessary to have a high degree of flexure at the bottom? A. No, it is not. Of course if the bottom depends entirely on flexure to compensate, then it is very essential that that flexibility be proper.

Q. Well, if an ordinary piston such as shown on Exhibit 14 is simply split from the bottom to the top without any cross-cuts at all, there will be flexure at the bottom, then? A. Yes.

Q. In fact the split need not go to the bottom at all, as illustrated for instance by Defendants' Exhibit 3-01.

Mr. Richey: We object to that as immaterial, a question regarding that piston.

The Master: He may answer; you may have an exception.

A. That is true. In Defendants' Exhibit 3-O there is a provision for the expansion at the bottom by very careful fitting and also usually by some kind of special grinding, and in this particular piston the diameter is small and the need for compensation is therefore small.

Q. In other words, in a small piston, even as large as Exhibit 3-O, the matter of expansion don't enter into it as much? A. Not as much as in the larger, but still it is sufficient so that no aluminum piston of the size of Defendants' Exhibit 3-O, so far as I know, is usable in present day pleasure cars without flexibility.

Q. You referred to special grinding, what did you have in mind? A. I mean in the first place a very careful fit between the bottom of the skirt and the cylinder barrel, and in the second place preferably an oval grinding of the bottom.

Q. You mean an oval grinding in which the diameter across the wrist pin bosses is less than at right angles thereto? A. Yes.

Q. In the Ford eight piston, Defendants' Exhibit 3-J, there is a special cam grinding resorted to, as shown on that exhibit, isn't there?

Mr. Richey: I would like to make the same objection. Piston, Defendants' Exhibit 3-J, has nothing to do with any issue in this case.

Mr. Bruninga: It has not?

Mr. Richey: Not at the present time. There is no proof that any of the defendants made, sold or used that piston or any evidence it is in the prior art.

The Court: Same ruling.

A. Yes, a cam grinding is resorted to in this piston.

Q. In order to get the effect of the keystone structure that I have referred to a number of times, is that right?

Mr. Richey: Same objection.

The Master: Same ruling.

A. It does get that effect in a sense, but it does a little more, it aims to make the relief quite exactly the amount required at the different places so that the piston will have a larger bearing area against the cylinder wall.

Q. Now, in the Gulick patent the drawing shows three distinct annular ribs on the inside going circumferentially around the skirt; isn't that right? A. Yes.

Q. And also a little inturned part at the bottom? A. Yes.

Q. And also inturned part at the top? A. No.

Q. Now, all of those would tend to stiffen the skirt circumferentially? A. Yes, that is true.

Q. Would you say that the yield of the web in the Gulick structure is the same as in the Jardine structure, I am talking about webs now as they are illustrated in Figs. 1 to 4 of the Gulick patent and 6 to 9 of the Jardine patent? A. I should say that the yield of the web perhaps is somewhat greater in the Gulick construction as shown than in the Jardine construction.

Q. Would you say that both of the vertical flexure and lateral flexure of the web? A. Oh, neither of them has any vertical flexure to speak of.

Q. In other words, there is no flexure in the Jardine which permits the bottom of the skirt to tip in? A. No, I think not, at least not to any great extent.

Q. Will you refer to the Jardine patent, Fig. 1, in connection with the descriptive matter beginning line 34 of page 2, and going down to line 53, the end of the paragraph, and tell me whether there is any vertical flexing contemplated there, particularly with reference to the line 13-13, Fig. 1?

Mr. Richey: I object to the question as immaterial. The one part of the disclosure has got to be taken in connection with the other part. What if one part don't say anything about vertical flexing, it is immaterial whether it does or not, unless you consider it with the entire disclosure.

The Master: Same ruling.

A. I can't see anything in there that refers to vertical bend, vertical flexing. The statement is that the web 6 will bend along a line extending vertically down from the ends of slots 11a, that is, the bending will be a horizontal bending, but it will be a horizontal bending along a vertical line as the axis of bend.

Q. That is the way you construe that language? A. Yes.

Q. Now, that line on Fig. 1 will correspond about to the line running from the inner end of the slot 29a on Fig. 6 of the Jardine patent, isn't that right? A. That is correct.

Q. And in Fig. 6 the slot is not shown as far in as Fig. 1? A. No.

Q. That shows a variation in the flexibility of that skirt; in other words the flexibility of the web 6 in Fig. 1 will be greater than in the webs 25 in Fig. 6? A. Well, I don't know what the flexibility requirements might be, what the size of the piston might be.

Q. Well, as far as those particular constructions are concerned, if the slot extends in further there will be greater flexibility of the web; you gather that from the sentence beginning line 40, page 2, don't you? A. Well, the means are described for helping the web to flex. In the first place the horizontal slots are put in at the top of the skirt, and then mention is made of proportioning the web thickness and also the skirt thickness to facilitate the flexing. I don't conceive that there is meant to be a particular difference between the one and the other in the function and mode of operation.

Q. Well, you said in answer to a previous question that there is no vertical flexing of the skirt slipper contemplated because of the slot 29a in Fig. 6 or the slot 11a in Fig. 1, but there is a lateral flexing contemplated of the web? A. Yes.

Q. Well, now, as a matter of fact with the same thickness of web, the closer that slot is placed to the center of the piston, I mean the slot 29a, Fig. 6, or the slot 11a, Fig. 1, the greater will be the flexibility of that web; is that right? A. That is true with a given height of web.

Q. I am assuming all the other dimensions to be the same? A. That is correct.

Q. So as a matter of fact it is true that taking the two structures, Figs. 1 and 6, that with the thickness of the web and the depth of the web the same, and with the diameter of the piston the same, the webs of Fig. 1 will have greater flexibility than those of Fig. 6? A. They might have, yes.

Q. Well, isn't it a fact they do have, Doctor? A. Well, I don't know whether there is any point to that. All these pistons are supposed to describe pistons that flex and also pistons that have certain other characteristics.

Q. Well, regardless of whether there is any point to that, Doctor, as a matter of fact isn't it so that my question should be answered in the affirmative? A. I don't know that it is. I would like to make a little study of it, if you think there is any point to it.

Q. What do you think, then, is meant by the statement here: "If said slots are terminated closer to the guide segments 10, 10a the region of bending will be moved outward correspondingly"? A. He means just what he says. He gives you a means for controlling the degree of flexibility so as to get greater flexibility if you need it or less flexibility if you don't have to have it.

Q. And he says he does that by the position of the end of the slot with reference to the surface? A. That is one means.

Q. That is the means that is mentioned right there? A. He also mentioned web thickness and he mentioned skirt thickness.

Q. I am coming to that. I am just assuming all the other conditions to be the same. That is the fact, then, isn't it, that if you vary the extent of the slot through the center of the piston, you vary the flexibility of that skirt? A. That is correct.

Q. Now, we will come to the thickness of the web. Now, Mr. Jardine describes here specifically in the next sentence, and also in the preceding paragraph, the feature that these webs 25 of Fig. 9, or 6 of Fig. 4, decrease in thickness from the cylinder wall to the boss, is that right? A. That is correct, as shown in the drawings.

Q. And the greater that decrease in thickness, all the other conditions being the same, the greater will be the flexibility of the web? A. That is correct. And also the less the absolute thickness.

Q. You don't find any specific description of that kind in the Gulick patent, do you, I mean of the tapering or the decrease in thickness of the web? A. No.

Q. You don't find anything of that either in Plaintiffs' Exhibit 1, the Sterling type piston? A. No, I think not.

Q. You don't find any cutting in of the web towards the center of the piston in that Exhibit 1, do you? A. No.

Q. How much of a cutting in do you find there, in inches, from the cylindrical wall of the skirt towards the center of the piston? Oh, about,—it is not over an eighth of an inch, is it? A. (After measuring same) Exhibit 1 is $\frac{3}{8}$ of an inch, approximately, in from the web. Of course what counts for flexibility is the distance to the outer diameter of the skirt.

Q. Where did you measure from; did you measure from this inside part to the part on the relief? A. I measured from half-way between the angular cut.

Q. Half-way to the relief? A. Yes.

Q. But you didn't measure from the half-way where the web turns in, where the web turns circumferentially? A. No.

Q. Those two points are just about on a line, are they not? A. That is something more than a quarter of an inch.

Q. And I suppose on an extreme relief, then, you would measure from the top of the keystone to the point of origin? A. What is the idea about where I would measure from?

Q. Well, I just want to know. A. Aren't we after flexibility in these skirts, webs and so forth?

Q. It is immaterial what you think. I want to know where you measured from in order to get that. A. That is according to what I want to find out.

Q. Well, if you want to get the length? A. No, if I want to get the flexibility—

Q. No, I want the actual length of the web. We will talk about flexibility later. The actual length of the web from where it is attached to the head to where the web ends. You said that is about a quarter of an inch; is that right? A. This particular web ends in the skirt, insofar as the structure of Plaintiffs' Exhibit 1 is concerned, as affects the flexibility.

Q. And I suppose if Mr. Jardine had a relief right out to the center, then you would measure from the point where the slot ends right out to the center of the relief? A. I would make the measurements which would be of importance in determining flexibility. When he makes a design to gain flexibility, then I should think it is flexibility we would be interested in.

Q. But the actual length of the web, now, where the web connects with the skirt, with the circumferential part of the skirt, is about a quarter of an inch in that Exhibit 1? A. From the inside of the piston, that is, from the point where the web is cut entirely through to the point where the relief ends, is something more than a quarter of an inch. Of course there is considerable flexibility, or some flexibility at any rate, in the web at the upper part where it comes down to the knife edge by virtue of the slotting operation which cuts the horizontal slots in the piston.

Q. Now, the Jardine patent structure, the thickness of the slipper from the center, that is where the split is, to where it joins the web, increases, does it not—the thickness increases from the center to where it joins the web? A. It does, as shown in the drawing.

Q. And you don't find that in Plaintiffs' Exhibit 1, do you, talking now from the part of the skirt from the split to where it joins what you call the web? A. It is difficult to say without a section, but I would assume that there is no taper there on the skirt.

Q. Now, you don't find any description in the Gulick patent as to definite proportioning of thickness of web to secure flexibility, do you? A. Yes.

Q. You mean a specific statement to that effect, that the web is proportioned to secure flexibility? A. Well, I will find what I had in mind on that point. (After examining patent) Beginning line 17, page 2, "The arrangement of the supporting flanges 17 between the ends of the piston pin bosses and the connections of those flanges with both the piston guide portion and the head provide a particularly strong construction, and at the same time, when the longitudinal split is used, as shown, the web structure has sufficient lateral flexibility to permit the split to close more or less under the action of the expansion forces incident to the heating of the piston."

Q. You think that is full and complete? A. Yes, that is a complete statement as to the function and mode of operation of those webs.

Q. Particularly from lines 24 to 27, isn't that right? A. Yes, when the longitudinal split is used; that is, from lines 23 to 27.

Mr. Bruninga: Well, just as part of the defense, in order to connect it up, I want to say that we will show that that was added by amendment.

Q. Now, you explained on your direct examination some peculiar action of flexing in the Jardine structure that I didn't quite understand. I understand the flexing of the webs all right, but I believe there was some peculiar structure that you described as the peculiar mode of operation from the head down, that is, when the head heated up, that there was a certain action took place. Can you elaborate on that a little bit, in other words, is there anything peculiar in the connection to the head that imparts particular virtue to that Jardine construction? A. Well, I mentioned two or three other

things besides flexibility which help to compensate for the extra expansion of the aluminum over the cast iron. One of those was the relief around the bosses permitting the piston to adjust itself to the cylinder wall by virtue of distortion. If the cylinder is round in cross section and the piston is round in cross section, then the expansion of the piston against the cylinder wall produces pressure at all points of the circumference and such pressure tends to make the piston rub too hard and eventually it may seize. If the piston is relieved on part of its circumference, then the pressure against the remaining part of the piston is available to help relieve the total pressure by distortion of the piston, the relieved portions having an outward movement. Now, that is helped also by the fact that you have the horizontal slots, that makes the distortion of the piston easier. Then there is also the factor of the excess expansion of the piston head causing the top of the skirt to expand more than usual as a result of its own temperature, and that I term mechanical expansion. In the Jardine construction that mechanical expansion would be one which normally should spread the slots farther apart. That would be resisted by the junction of the skirt or guide sections with the side walls of the cylinder, and the effect of it is to produce distortion in the piston, if there are no slots. If there is only one slot it also produces distortion and draws the bearing face inward, thus assisting with the clearance on that particular side. Now, if there are two slots it perhaps calls in a greater demand for the action of the flexible features of the skirt.

Q. As I understand, then, the characteristic features of such a construction in order to secure that result, are first reliefs opposite the wrist pin bosses? A. Yes.

Q. Second, some sort of a horizontal slot? A. Yes.

Q. Third, some sort of a vertical division or slot between the wrist pin bosses? A. Well, to get the maximum effect, yes, the vertical slot must be there. That is, in order to get the maximum compensation for excess expansion, the vertical slot must be there.

Q. And it is your position it don't make much difference whether it is a structure like Plaintiffs' Exhibit 1 in which there is a large relief, or whether it is a structure like Defendants' Exhibit BBB, of course slotted entirely through, in which there is the relief cut into the piston wall?

Mr. Richey: You are assuming Exhibit 1 is out entirely through?

Mr. Bruninga: Yes, I am assuming they are out all the way through.

A. Those two structures function substantially the same.

Q. And it don't make any particular difference whether the slot is on one side or both sides, the horizontal slot, one side or both sides of the piston? A. Well, it makes a difference, yes. There are other things that have to be taken into consideration if the slot, the horizontal slot is restricted.

Q. You say you would still have the advantageous features? A. Yes, you have a much more difficult problem in making an integral single-walled piston and making the structural changes necessary to compensate for the excess expansion, than you do in the double-walled piston. Many of the detail changes in the single-walled piston produce the same general effect but in somewhat different way.

Q. And it don't make much difference whether the vertical slot is exactly in the center of the skirt or not, exactly between the two wrist pin bosses in the center of the slipper, or exactly in the center between the two wrist pin bosses? A. Whether it is exactly in the center or not I think makes much less difference than it does whether it may be opposite the wrist pin bosses; that is, the slot should be between the wrist pin bosses.

Q. That is what is essential? A. Yes, in these constructions.

Q. That is your position when you consider this Jardine patent and what it teaches, taken in general and not in details like we are talking about? A. Yes, it teaches a broad principle. The Jardine patent, I think, teaches for the first time the means for getting a single-walled piston which by combining several features so as to compensate for the excess expansion especially at the top of the skirt, produces a result not theretofore produced.

Q. And what you have described is the structure of a piston like I am handing you now, marked for identification Defendants' Exhibit 3-Q? A. No.

Mr. Richey: If your Honor please, I want to make an objection to this. It is a question relating to something that wasn't inquired about in direct ex-

amination, and highly improper at this time. It is apparent that my adversary is going to contend that this is one of the prior art patents, that has not been referred to at all either in any of the patents in suit or in the direct examination.

The Master: Same ruling.

Q. Isn't this structure one which is relieved opposite the wrist pin bosses or can be readily relieved opposite the wrist pin bosses?

Mr. Richey: May I object to all this testimony regarding this particular thing, and may defendant's counsel be required to state how this thing has anything to do with the issues in this case? Is it pleaded as a defense, if so, what defense? To what issue made up by the pleadings does this relate? Certainly you cannot bring in anything, whether it relates to the issue or not.

Mr. Bruninga: Here is my position: this witness is not put on the stand as the ordinary shop man to come in there and explain structures, but he goes to the extent of saying, again and again here, that is just a detail, it contemplates other things. Now, when he takes a position like that, I can face him whether it covers this or not. It is just too bad if it happens to be a prior art device. And the position is taken here that the patents cover two diametrically opposed pistons, the Ray-Day and the Sterling type. These are stretched to the breaking point, and where plaintiff takes a position like that I can certainly cross examine this witness right now whether he intends to include anything like that. This is not the ordinary case at all.

The Master: I am going to permit the cross examination. You can have your exception to it. If it is improper it can go out at a later time.

Mr. Richey: Will he be required to say if this relates to the prior art construction? What he says simply is in any case you can go outside of the issues.

The Master: No, that is not the point. This man comes here as an expert. He testifies as to certain principles. It seems to be he can be controverted with questions concerning those principles, and that is what this is.

Mr. Richey: Even though they are outside of the direct examination and the specific issues?

The Master: I don't say they are outside. I don't think they are outside.

Mr. Richey: He talked definitely about the patents in suit and the devices charged to infringe.

The Master: I am going to let it in, you may have your exception.

A. (After question is read) It can be readily relieved opposite the wrist pin bosses.

Q. But as far as you can say that particular model is not relieved opposite the wrist pin bosses? A. No.

Q. But it does have a horizontal slot between the wrist pin bosses on each side? A. Yes, and above the bosses.

Q. And it has at least one vertical slot between the wrist pin bosses, connecting it with that horizontal slot? A. No, it has no vertical slot.

Q. Oh, it has no vertical slot? A. No.

Q. Why, because the slot don't go all the way through? A. That is correct.

Q. And you make that distinction? A. I certainly do.

Q. You make that distinction that the slot which don't go all the way through is not the same as one that goes all the way through? A. No, I make the distinction that a vertical slot for the purpose of gaining flexibility must serve that purpose, and these "accordion pleats" in that piston do not serve that purpose; in fact, they are strengthening ribs, that is about what they are.

Q. It is your position, then, that they don't impart any flexibility to the skirt? A. Practically so; that is practically as rigid as a trunk type piston.

Q. That is your position? A. Yes.

Q. Even if it has relief opposite the wrist pin bosses? A. That makes no difference in the rigidity.

Q. Not a bit. But the skirt is separated from the head at least 180°, isn't it? A. Approximately, yes.

Q. About as much as in Plaintiffs' Exhibit 1? A. Yes.

Q. But your position is that this particular piston is just as rigid as an ordinary trunk type piston? A. Practically so. I have measured them.

Q. Did you ever measure this one? A. No, but I have measured pistons that have that construction.

Q. And a description that would state that it is flexible, would then be wrong? A. Yes, it is wrong, any

description which says that piston is flexible laterally is wrong.

Q. Dr. Jeffries, you were retained to expert the Simmons suit, were you not? A. No.

Q. You weren't? A. No.

Q. Don't know anything about it? A. Yes.

Q. You know of course a patent describing that structure was included in the Simmons case, don't you? A. Yes, certainly.

Q. You also know, or rather counsel has admitted, this particular piston here was alleged to be an infringement of that patent? A. I don't know that.

Q. Counsel has admitted that. You disagree, then, that this piston don't have any of the characteristic features of that piston (referring to Defendants' Exhibit 3-Q and Plaintiffs' Exhibit 1)? A. Did I say that?

Q. Well, I am asking you. A. I don't know.

Q. It does not have the flexible feature, does it? A. No.

The Master: The 3-Q, what do you call that?

Mr. Bruninga: Call it the ribbed piston.

Mr. Richey: You know what you call it.

Mr. Bruninga: It is known as the Franquist piston?

The Witness: Yes.

Q. Wasn't that piston used in the Pierce-Arrow car—I am not asking you about the date? A. I don't know. That would mean nothing. A trunk piston was used in a Pierce-Arrow car, too.

Mr. Richey: You claim it is made after the Franquist patent 1,163,902, in the prior art?

Mr. Bruninga: Yes.

Q. Doctor, did I ask you to bring in a Ricardo piston? A. No.

Q. I thought I had. A. I didn't recall you had. I brought in everything you asked me.

Q. I will take your word for it. Wasn't that Ricardo piston used in the Dodge automobile a number of years ago? A. Not that I know of.

Mr. Richey: Now, are you referring to the piston shown in Ricardo patent 1,294,833? Let's find out what you mean by the Ricardo piston.

Mr. Bruninga: I thought the witness knew.

Q. Since he hasn't produced a piston I will ask him whether the Ricardo piston is properly illustrated in patent 1,294,833?

Mr. Richey: Properly illustrated, how does he know? What are you talking about? Are you talking about the one in this patent?

Mr. Bruninga: Whether the Ricardo piston we talked about yesterday is illustrated in that patent.

The Witness: Yes.

Q. You can answer that, can't you? A. Yes.

Q. Who are now using pistons illustrated in the Maynard patent, what automobiles? Are all of those using the piston that you mentioned; or don't you remember which ones you mentioned? A. Well, I couldn't give you a list, but the information I suppose would be obtainable.

Q. Well, some of those that have used the piston illustrated in the Maynard patent have quit using it? A. Yes.

Q. Including Chrysler? A. Oh, I think Chrysler has not quit using it. They are using a different design of piston in their new models.

Q. Not a single one of these General Motors cars uses an aluminum piston at all? A. Not the pleasure cars.

Q. The trucks do? A. Yes.

Q. And they use the straight non-split piston of what kind? A. I don't know what kind they are using.

Q. Now, you mentioned there were only a few people that were manufacturing pistons made in accordance with the patents in suit outside of the licensees, of which you mentioned Sterling and Ray-Day, and some people on the coast. How about Thompson Products Company? A. They are not manufacturing these pistons to the best of my knowledge.

Q. Not even selling them? A. Oh, yes, selling pistons.

Q. Selling pistons made by licensees or by non-authorized persons? A. They are selling pistons made by the United States Aluminum Company. Beyond that I don't know.

Q. Did you know there was a suit filed in this district and a consent decree entered against Lawrence-Ohio Company, one of the vendees or jobbers of the Ray-Day pistons? A. Yes.

Q. Do you know that there is a suit now pending in Detroit against the Ray-Day Company? A. No.

Mr. Richey: There is, we concede that.

Q. Have you found motor car companies very anxious to avoid infringement suits? The fact is that they don't like to get into infringement suits, motor car companies? A. I don't know whether I can make any general statement on that subject.

Q. Well, you know the position of the motor car companies in the industry that have put out thousands and thousands of cars, sometimes thousands per day, each having from four to sixteen pistons, do you find that they take chances on infringement, in your contact with that industry? You seem to be familiar with the automobile industry and what their attitude is. A. Some of them take chances, I am sure of that.

Q. Has any automobile manufacturer taken a chance in any piston suit in the last 20 years, to your knowledge? A. Yes.

Q. What company? A. Ford, for example.

Q. On a piston? A. Yes.

Q. What piston was that? A. The Sterling piston.

Q. The Sterling piston, you mean the piston we have here now? A. Yes.

Q. Exhibit 1? A. Well, I don't know whether it is exactly like Exhibit 1.

Q. Has Ford been notified of this suit? A. I don't know.

Q. Well, have they taken a chance to defend any suit at all in the courts? A. I don't know.

Q. You don't know of any motor car company that has in the last 20 years taken a chance to defend a suit on a patent involving a piston?

Mr. Richey: I object to this as immaterial.

The Master: He may ask him if he knows.

A. Yes, I think I can say that I do.

Q. Which one? A. All the ones that started to use the Invar Strut piston in the earlier days.

Q. And a suit actually filed against them? A. I don't think suits were filed against them but they took a chance.

Q. Well, it wasn't even necessary to litigate that patent in the courts against a motor car manufacturer, was it, on the strut piston? A. No, it wasn't necessary, or hasn't been, at any rate.

Q. And by the strut piston you mean this piston, Exhibit AAA? A. Yes, that is one of the Strut patents.

Q. You didn't mention Mr. Long as being one of the parties who operated in defiance of the patents in suit. You know that Long and his company has operated in defiance of the patent in suit? A. No, I didn't know that.

Q. You didn't know that a suit was filed against Mr. Long by Cleveland Trust Company and the Long Piston Company in Detroit a number of years ago? A. No.

Q. You don't know that that was dismissed, either, do you? A. No.

Q. You don't know that it involved any patents in this suit? A. No.

Q. Aluminum Manufacturers was formerly the Kant-Skore Company? A. No, Aluminum Industries.

Mr. McCoy: Aluminum Industries, Incorporated.

Q. Aluminum Industries, Incorporated, is simply the old Kant-Skore Company with the name changed? A. I think there was an enlargement of activities when the name was changed, but it is the successor company of the Kant-Skore.

Q. And that company took a license under the Cleveland Trust Company patents after the settlement in Cincinnati in 1923 of the mold patents? A. I think so.

Q. And those molding patents are the same ones involved in the St. Louis suit with the exception of the few additional ones in the Kant-Skore case? A. Some of the molding patents were the same.

Q. And the license under the molding patents, and the license under these Cleveland Trust patents were given to Kant-Skore just about the same time? A. I don't know the dates.

Q. But after the settlement of that suit? A. Yes.

Q. And Bohn Aluminum & Brass Company also took a license under both sets of patents after the Kant-Skore suit was settled? A. Yes.

Q. And you happen to know that Mr. Bohn's attorney represented Kant-Skore at that trial? A. I think so.

Q. Now, as I understand it, then, there are these licenses; there is Aluminum Industries, formerly the

Kant-Skore Company, Bohn Aluminum & Brass Company in Detroit, and United States Aluminum Company, which is a subsidiary of Aluminum Company of America, and Aluminum Company of America; am I right? A. Those are the licensees under the Cleveland Trust patents.

Q. Under the Cleveland Trust patents? A. Yes, I think the direct licensees are the Aluminum Company of America and Bohn Aluminum & Brass Corporation, and that Aluminum Industries is, perhaps a sub-licensee of the Aluminum Company of America. I don't know just how that is.

Q. In other words, as you remember it, it is a round-about license from Cleveland Trust Company to Aluminum Company of America, and then to the Aluminum Industries, Incorporated? A. I think Aluminum Industries is a licensee from Aluminum Company of America.

Q. And Bohn bought the licenses of National Piston Company and Levett & Company? A. I think so.

Q. And both the National Piston Company and Levett & Company were licensees under the Cleveland Trust Company patents? A. I think so, yes.

Q. Did Bohn take a direct license, do you know? A. I don't know. I think he has a direct license.

Q. It has been the practice for these licensees on pistons to assign their patents to Cleveland Trust Company; that has been the practice, hasn't it? A. It is with the Aluminum Company of America. I think some provision was made for the others as well, I am not sure.

Q. Well, you don't know of any patents that Aluminum Industries hold? A. In their own name?

Q. In their own name? A. No, I do not.

Q. You don't know of any split piston patents that Bohn Aluminum & Brass Company holds in its own name? A. No, I don't know of any specific ones.

Q. It never has been necessary to split the cast iron piston, has it? A. I think not, it has not been absolutely necessary; it might be helpful in some cases, I am not sure.

Q. The Exhibit 3-H is practically a piston as used today? A. Yes, I think it is.

Q. And the reason it has not been necessary to split a cast iron piston is that the coefficient of expansion of cast iron is so much lower than aluminum it don't really enter into play? A. That is correct.

Q. And the piston operates in engagement with a cylinder which is also cast iron; therefore has the same coefficient of expansion as the piston? A. Yes.

Q. So you rather would not expect any compensation for expansion in the cast iron piston except that due to the greater heat applied to the piston as distinguished from the cylinder? A. That is correct.

Q. And it was not until aluminum pistons came into use that it was really necessary to compensate for expansion? A. That is correct.

Mr. Brunings: Now, that finishes my cross examination of this witness. With reference to the production of the licenses, that might be taken up in connection with this matter of Chrysler, if you want to proceed with this witness right now, if I can do so. I want those licenses produced, and I think I have a right to have them produced. I can't take this witness' or any other witness' word for the fact royalties have been paid until I know what the condition of the payment is.

(Short recess taken.)

RE-DIRECT EXAMINATION by Mr. Richey.

Q. In connection with your answer to the last question of the cross-examiner regarding the necessity of flexibility in the aluminum piston when it arose, will you explain just when that necessity did arise and how long before it was worked out, as far as you know? A. Well, it was a problem in 1915 when I first became connected with the Aluminum Castings Company and it was a problem continuously on pleasure car vehicles until it was solved and the real solution of it didn't come until, oh, approximately 1920, and commercially not until a while after that, what might be called a real commercial success, with a means for compensating for the extra expansion of aluminum.

Q. Now, you were asked about your relative position in the suit on these patents here involved and those involved in the suits in St. Louis and San Francisco. Will you state, succinctly, what your positions are or were with respect to the contributions made to the success of aluminum pistons by those two groups of patents? A. The groups of patents in suit in the St. Louis and San Francisco cases were for molds, processes for making hard, sound, tough, durable piston castings and the product so produced. The position I took in connection with

the so-called mold process and piston casting patents is that they were the developments which made possible the commercialization of the aluminum alloy piston. They did so because of the soundness, high strength of the metal resulting from this special method of casting, and in the chilling when certain families of alloys were used. That is the process as has been testified to in the other suits, under which more than a hundred million pistons have been made in the United States alone since 1915. That is the method by which practically all of the pistons made and used today are produced. Now, in this particular case, this represents an additional group of patents relating to the design of the piston and to methods for compensating for the excess of expansion of aluminum as compared with cast iron for the purpose of making the aluminum alloy piston function properly as regards bearing, oil pumping, slapping, sticking and so forth, so that full advantage can be taken of its lightness and its high heat conductivity and of the properties imparted by these other processes of which I spoke.

Q. And it was some years after the processes, molds and so forth involved in the first suit were worked out before this scheme for taking care of the compensation employed in the patents in suit was worked out commercially? A. Yes, to a satisfactory solution or result.

Mr. Richey: As preparatory, I might say I examined this witness regarding the prior art, which defendants' counsel asked him about, without waiving my right to go into it in rebuttal.

Mr. Bruninga: You understand I don't waive.

Mr. Richey: We have a different situation. You have gone into prior art when you have no right to do it. I am not going to leave the thing open, at the same time I am not going to waive my right to take testimony in rebuttal in regard to it.

The Master: I understand the situation; you may proceed.

Mr. Bruninga: I just don't want to waive any position I have.

The Master: All right, proceed.

Q. You were asked about the Ricardo piston and the work done upon it or in connection with it. You were connected with the predecessor of the United States Aluminum Company along in 1915 and up, weren't you? A. Yes.

Q. You have spoken of the difficulties with the trunk type aluminum piston. Do you know what if any efforts the United States Aluminum Company or its predecessor or associated companies made to try to find a solution for that situation? A. Yes.

Q. Will you just tell us what those efforts were, and when they began and what were the results of them? A. The efforts were continuous from the time that I became connected with the Aluminum Castings Company in 1915. Not only were they continuous but they were strenuous. We heard of various designs of pistons in various ways to take care of the excessive expansion, and a number of such things were tried out and a number dismissed as seeming impractical, and that was a problem that was continuously before the Aluminum Castings Company between 1915 and the end of the war. The war activities minimized the international exchange of ideas, as everyone knows, but shortly after the war was over, namely, early in 1919 or approximately late in 1918, I recall the beginning of interchange of international ideas on the subject. After a survey of what was available abroad and the information that had been gained over there, it seemed to us that the Ricardo piston perhaps represented the best that they had to offer from abroad. There were three engineers in the United States from England shortly after the war, all of them interested in exploiting the Ricardo piston in the United States. One of those is an internationally famous automotive engineer, Lawrence Pomeroy. Another man who appeared to have the business negotiations as his responsibility, was Major Halford, but he also represented himself as an engineer. Another engineer by the name of Parnell, as I recall his name, was in this country for the purpose of handling the details of testing and installation of the Ricardo pistons. The Aluminum Castings Company was in contact with these gentlemen and tried out the Ricardo pistons early in 1919. The laboratories at Harvard Avenue were almost turned over to the piston problem in the Spring of 1919. It seemed that there was little time in the dynamics laboratory, at any rate, for anything else but piston tests. These Ricardo pistons were made under the supervision of the Ricardo representatives and tested partly under their supervision and partly under our supervision. The tests were exhaustive. There was considerable impatience on the part of the Ricardo representatives with reference to the delay in approval by the

Aluminum Castings Company or its successor. I just don't remember the date of the incorporation of the Aluminum Manufacturers, Incorporated, but that makes no difference, because my relations at any rate did not change over there, neither did those of a number of other people in the laboratory. The Ricardo pistons, however, were unsuccessful. If fitted closely enough to avoid noise, they seized. If fitted loosely enough to avoid seizure, they made noise; and there was also trouble from oil consumption. As I recall it, every expedient for making the pistons work was tried out and still the pistons were not successful. The solution appeared to be at hand with the Jardine piston, and after that the direction of work in the Aluminum laboratories has been largely along refinement, perfection and change of the flexing method, and also in the direction of the utilization of the Invar Strut.

Q. By reference to the Jardine piston, you mean the piston of the Jardine patent in suit here? A. Yes.

Q. Now, who was Harry R. Ricardo? A. He is quite a noted English automotive engineer.

Q. And was he prior to the time his patent was taken out? A. Yes.

Q. Now, who was trying these expedients to make this Ricardo patent work? A. Both Mr. Parnell, representing him, and Mr. Jehle, who was in charge of the tests.

Q. That is Mr. Ferdinand Jehle, now an engineer with the White Motor Company? A. Yes.

Q. And he was a well known engineer at that time, too, was he? A. Yes.

Q. Anybody else there working on the problem, observing the tests? A. Yes, Mr. Wesley, Mr. Carpenter, Mr. Allyn and Mr. Blank, who is also an automotive engineer with the White Motor Company, Mr. Jardine, as well as myself.

Q. Mr. Welty there also? A. I think he was not there at that particular time.

Q. And those people you have named are automotive engineers, aren't they? A. Not all automotive engineers, no.

Q. Well, many of them were, weren't they? A. Yes.

Q. Mr. Pomeroy also? A. Oh, Mr. Pomeroy, yes.

Q. Mr. Parnell? A. Mr. Pomeroy was actively interested in the tests and also Mr. Parnell.

Q. What kind of tests were made on the Ricardo piston? A. Engine tests, the tests that I have named were made in the laboratory, but pistons were also fitted to motors in cars.

Q. That is the usual indoor and outdoor tests? A. Yes.

Q. Over what period of time were these tests made? A. The tests were going on rather actively in, I should say, it was a period of four or five months at any rate.

Q. Now, you were asked about the commercial use of the piston of the Jardine patent. Will you state what was done towards developing that piston for commercial use after it was first invented by Mr. Jardine? A. There was an attempt to commercialize the Jardine piston in the slipper form and tests were under way in a number of places, both laboratory and road tests, and the piston was receiving favorable consideration. I don't recall the exact date but I do recall an instance of tests in the Templar car here in Cleveland, which were quite satisfactory. But by the time the Jardine piston was found to be satisfactory from the standpoint of taking care of clearance, as mentioned yesterday, the Maynard piston became available and it was a preferable construction.

Q. And it was elected to push the piston shown in the Maynard patent instead of that in the Jardine patent? A. That is correct.

Q. How far had these tests on the Jardine piston gone with respect to the commercial utility? A. So far as I recall, the effect on the organization, on the inside, was that we felt the problem had been solved and it was only a question then of the proving in in the field, and that proving in had gained considerable headway by the time the Maynard piston came along and proved in still better.

Q. Will you compare this piston shown in this Ricardo patent 1,294,882, in structure, mode of operation and results, with the pistons of each of the patents in suit? A. Considering first the Gulick patent, the construction shown in the Ricardo patent is not the same as that shown in Gulick, although it does have some similarity in that the web are depending from the head portion proper in which the wrist pin bosses are mounted. The skirt construction is quite different from that shown in Gulick, and the method of operation is different, in that Gulick shows flexibility of the skirt and Ricardo does not. The

result is different because Gulick gets compensation for extra expansion and Ricardo does not.

In so far as the Jardine construction is concerned, that shown in Figs. 1 and 2 is quite similar to that of Ricardo. The web sections of Ricardo are considerably thicker than those of Jardine. The Ricardo piston apparently is made for rigidity and stiffness, where the Jardine construction is made for rigidity only in the vertical direction, but is made for flexibility in the lateral direction. In so far as mode of operation is concerned, the mode of operation is different in the Jardine patent from what it is in the Ricardo construction, because Jardine is designed to operate by utilization of the flexible webs and skirt and Ricardo is not. In so far as result is concerned, the Jardine attains the result which the Ricardo does not. The Ricardo cannot be fitted closer than the trunk type of piston, for example, whereas the Jardine construction can be fitted in the cylinder much more closely. The construction, even in the Jardine Figs. 6 and 7 is different from that shown in the Ricardo patent. This is a matter of history on that point, I might mention that the construction shown in Figs. 6 and 7 of the Jardine construction was capable of being manufactured in a permanent mold. Now, the Ricardo construction is not, or at least was not at the time, with the molding art available, but nevertheless the Aluminum Castings Company had in mind that they could not put an aluminum alloy piston on the market and make it successful unless it were cast in a permanent mold. The Ricardo people insisted, however, on this type of construction as shown in the Ricardo patent, as having peculiar advantages and insisted that unless we utilize that construction we did not have a Ricardo piston. So that the construction shown in Figs. 6 and 7 of Jardine is different from that of Ricardo by virtue of the direct connection of the webs to the bottom of the ring flange rather than the connection of the webs to the head of the piston. The Ricardo construction is, then, in part a two-walled structure, whereas the Jardine construction shown in Figs. 6 and 7 is a single walled construction.

In so far as the Maynard patent is concerned, the construction is different from Ricardo, the mode of operation is different and the result is different.

With respect to Mocera, the construction is of course different but the Ricardo piston has relief around the bosses and it has separation of the skirt from the head,

so that the Ricardo piston might be capable of some distortion and it might also have its skirt temperature reduced somewhat at the top in the center of the thrust faces, utilizing the principles outlined in the Mooers patent.

Mr. Richey: Just a minute, I withdraw that part of the question that refers to the Mooers and Schmiedeknecht patent because I see the Ricardo patent is subsequent to those two in filing date.

The Master: You want to strike that out?

Mr. Bruninga: No, I don't think it ought to be stricken out. It is pertinent here. I think counsel has a right to withdraw as to Schmiedeknecht but the witness has already answered with respect to the Mooers patent.

Mr. Richey: All right, I will withdraw only with respect to Schmiedeknecht.

Q. You were asked this morning about the slots as shown in the Jardine patent in suit at 11a in Fig. 1 and 29a in Fig. 6, and in Plaintiffs' Exhibit 1. Will you state whether or not any modifications of operation, resulting from the difference in the length of these slots, would be a matter of degree or matter of kind? A. It would be a matter of degree.

Q. You were asked yesterday to produce specimens of pistons made under the patents in suit in which the edge of the relief was straight instead of inclined, and produced the two unfinished castings, Exhibits 3-M and 3-N. Will you state why you did not produce finished castings? A. The finished castings were not available, I couldn't locate them.

Q. Have you produced drawings which show the piston which is finished from these two castings? A. These two drawings have just come in and I have not had an opportunity to compare them with the pistons as yet. Drawing D-2376 X—

Mr. Richey: Marked for identification Plaintiffs' Exhibit 21.

A. —appears to be the drawing of the finished piston, of which Defendants' Exhibit 3-N is an example. The drawing and the piston both have the same number, namely, 481,678.

Mr. Richey: The next drawing I mark for identification Plaintiffs' Exhibit 22.

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A. (Continued) This drawing is also one for the finished piston of Defendants' Exhibit 3-M, both the drawing and the piston have the number 323,135. The number of the drawing is D-2460-X.

Q. Were the pistons illustrated in the drawings marked Exhibits 21 and 22 made and sold? A. To the best of my knowledge, yes.

Q. In substantial quantities? A. Yes.

Q. Now, those, each drawing shows this line vertical, does it not? A. Yes.

Mr. Richey: I offer these drawings in evidence as Plaintiffs' Exhibits 21 and 22.

Q. The line to which I referred in the next preceding question as being vertical, was the line showing the boundary between the web and the thrust faces, which I mark XX in each of the pistons. That is the same line you referred to in your answer to that question? A. Yes.

Q. I show you this large drawing of Ray-Day pistons, being marked for identification as Plaintiffs' Exhibit 23. Will you compare that with Plaintiffs' Exhibit 8, the Ray-Day piston? A. That is a drawing of the piston similar to Plaintiffs' Exhibit 8. The bottom drawing shows the piston with part of the head and part of the skirt removed.

Mr. Richey: I offer that large drawing in evidence as Plaintiffs' Exhibit 23.

Q. Now, you were asked about the litigation over these process, mold, etc. patents, and about the Kant-Skore suit. Was that suit tried? A. Yes.

Q. You were asked about the automobile companies taking chances on patent suits. Do you know anything about their organization with respect to the National Automobile Chamber of Commerce? A. Not enough to testify about it.

Mr. Richey: It has been agreed that the witness may cut through the slots of Plaintiffs' Exhibit 1 and Defendants' Exhibit BBB, in order to make them as actually used. I produce a hack saw and ask this witness to do that.

Mr. Brulings: I am willing to (delegate this witness to do so.

Q. Will you compare Defendants' Exhibit BBB as if the slots were cut through, in the structure, mode of oper-

ation and results, with the piston disclosed in each of the patents in suit? A. What I said with reference to Plaintiffs' Exhibit 1, assuming the slot is cut through, and Plaintiffs' Exhibit 17, with reference to the patents in suit, applies to Defendants' Exhibit BBB, with this understanding, that the extension on the inside of the piston above the bosses serves as the connection between the piston head and the piston skirt the same as the web connection in Maynard and in Plaintiffs' Exhibit 1. The extensive, and considerable relief of the skirt portion around the bosses is the equivalent insofar as function and mode of operation are concerned, to the web of Maynard. The construction is in my opinion an impairment of Maynard inasmuch as the bosses are not mounted as rigidly as in Maynard and the skirt section is made extra thick so that the skirt around the bosses can be cut away for relief. The skirt sections are therefore thicker than need be, or thicker at least than would be required in the Maynard construction. The Defendants' Exhibit BBB is more nearly like the Mooers construction at the top of the skirt because of the short connectors and the relief opposite such connectors. I would not say that Defendants' Exhibit BBB had anything to do or anything in common with the Schmiedeknecht patent.

Mr. Brunninga: I am perfectly willing to stipulate that the same defendant that sells Defendants' Exhibit BBB also sells Defendants' Exhibit CCC.

Mr. Richey: You mean they sold it between the date of the issue of the youngest patent in suit and the filing of the bill of complaint?

Mr. Brunninga: I don't know whether it was prior to the filing of the bill of complaint, but I understood it was sold since. If you want to have it before the Master I am perfectly willing to have it in the case so as to settle all these difficulties between these parties.

Mr. Richey: Well, I think I will defer my answer until I can make it complete, that is, I would like to take it with me this week-end.

Mr. Brunninga: I am perfectly willing you should do that, Mr. Richey.

Q. You were asked about Mr. Jardine and Mr. Maynard and their position as engineers. Will you state what their positions were in the automobile industry as engineers back in 1920 and '21 and along there? A.

Frank Jardine was automotive engineer for Aluminum Manufacturers, Incorporated, specializing on pistons at the time, and I can give that information from my own knowledge. My information with respect to Mr. Maynard is not from my own knowledge. I understand, however, that he was an automotive engineer for the Maxwell Company.

Q. Is there anything in the pistons of the Jardine patent in suit which back up the thrust on the thrust faces, particularly the faces on which the maximum thrusts come? A. Yes, the webs are located in such a position as to support the piston during the side thrust and also one of the slippers is made larger than the other, and it is the intention that the slipper with the largest face shall be used in the position of maximum thrust in the motor.

Q. Do you know why Exhibit 20, the Gulick piston produced by you, was made of that particular size, and if so state why? A. I can't say of my own knowledge why it was made of this particular size, but I think the record is pretty clear in the interference proceedings that it was actually made for an Oakland motor and it can be seen that it is the same size as the Oakland piston casting, Defendants' Exhibit 3-N. To the best of my knowledge this is a piston for a motor which was commercial at the time it was tested, namely, the Oakland motor.

Mr. Bruninga: I have no objection with reference to this piston produced on cross examination and offered in evidence because the matter of ex parte tests simply goes to the weight, not to the admissibility of the evidence at all. I understood there don't have to be any objections as to the weight of the evidence.

Mr. Richey: Well, we won't seek to take any advantage because you have delayed your objection. We are willing it should stand just as though you had made it at the proper time.

Mr. Bruninga: I would like to ask one question. In the Eighth Circuit it is not necessary to take exception to the rulings in an equity case. I understand that is the general rule in the United States. I don't know whether it is necessary here or not before the Master.

Mr. Richey: I understand that is the rule. If it is not, we are willing to agree we don't have to

take exceptions, and it will be understood we take one wherever the ruling is against us.

The Master: That is as I understand it. Where there is an objection as to a line of testimony, I understand that same objection continues and the same ruling throughout the case, without repeating so that it encumbers up the record.

Q. What if any effect would there be on the mode of operation and the results of Exhibit 20 if the size of the piston was changed within the limits of sizes of automobile pistons used in the industry, and assuming the proportions were kept the same? A. The larger the piston, the easier it is to be made flexible, so that the fact that this piston is small and flexible as no indication that it could not be made flexible if it were made larger. In fact, it would be somewhat easier to make it flexible if it were made larger. I don't mean necessarily it would flex with less actual force. Of course there would be more force used in the larger piston to make it flex.

Q. What if any changes would there be in the operation and results of making it larger? A. None excepting possibly in degree.

The Master: I think we will have to adjourn here.

(Adjournment taken to 9:30 A. M., Monday, January 23, 1933.)

(At 9:30 A. M., Monday, January 23, 1933, the hearing was resumed.)

(Same appearances as last noted, except Mr. McCoy absent, and John Sutherland, Esq., of St. Louis, also appearing with Mr. Bruninga for defendants.)

Mr. Bruninga: I admit that since the issue of the latest patent in suit, the defendant F. E. Rowe Sales Company have sold in this district pistons exemplified by Defendants' Exhibit CCC; that these pistons have been furnished and supplied to customers in this district with the skirt completely slotted through, or with the slot partially completed, in the same manner as shown in Exhibit 7, with directions to the customer like those given on Exhibit 7 to complete the slot; it is agreed that the above acts may be treated with the same force and effect as if they were committed before the filing of the

bill in the Rowe case herein; I am also willing to admit that if F. E. Rowe were called as a witness he would testify under oath that such pistons were purchased by his company of Sterling Products Corporation of St. Louis, and that when so purchased the slot was incomplete and he received instructions from Sterling Products Corporation to complete the slot or have it completed before the pistons were used, all as if between the date of the youngest patent in suit and the filing of the bill in the Rowe case. This last part being, however, subject to the motion to strike and expunge when the master passes on the main question.

I also admit the same with reference to Defendants' Exhibit 3-J, with the same reservation.

Mr. Richey: In view of the above admission, plaintiffs and each of them charge that Defendants' Exhibit CCC infringes the following claims of the following patents in suit:

That Exhibit CCC infringes the same claims of the Gulick patent as Exhibit BBB, as previously announced.

Exhibit CCC infringes claims 1, 8 and 10 of the Jardine patent.

Exhibit CCC infringes claim 6 of the Maynard patent.

Exhibit CCC infringes claims 3, 4, and 11 of the Mooers patent.

We make no charge of infringement of any claim of the Schmiedeknecht patent by Exhibit CCC.

These charges of infringement are made without waiving our right to assert in future suits and otherwise any claims under any other patents which the plaintiffs or either of them may now have or later acquire, and which are not included in this suit.

With respect to Exhibit 3-J we reserve our announcement until we have time to go over this matter carefully. I understand that my brother on the other side agrees that if we cannot announce our position with respect to Exhibit 3-J during our prima facie case we may later amend the prima facie case to include it, with the permission of the court.

Mr. Bruninga: I would like to have that done before defendants close their case.

With reference to the reservation made by counsel, that of course depends upon circumstances about

which I may know nothing. Counsel can announce his reservation, but I don't want to be in a position where I acquiesce in it at this time.

I mark for identification as Defendants' Exhibit 3-R the half section of the piston or rather a model showing the construction of the Gulick patent, which was produced during the examination of Dr. Jeffries on cross examination.

Mr. Richey: All these arrangements are all right with the court, are they?

The Master: Yes.

Mr. Richey: I think the record ought to show that by agreement the slots in Exhibits 1 and BBB have been cut through with a hack saw so as to complete them. This work was done between the last session and the present session.

Mr. Bruninga: That is correct. I want to further agree that Dr. Jeffries may be delegated to complete the slots in other pistons in which they have not been completed and which are on exhibit.

Mr. Richey: You haven't said on the record you agree to amending our prima facie case if necessary. I understood you did agree.

Mr. Bruninga: Oh, yes.

The Master: He agrees to it with the reservation that he would have the chance to answer.

Mr. Richey: Oh, yes, certainly.

Mr. Bruninga: I understood that evidence with reference to Exhibit OOC was to be put in before we close our case.

Mr. Richey: OOC but not 3-J.

Thereupon EAY JEFFRIES resumed the stand for further Re-Direct Examination by Mr. Richey.

Q. Will you compare the piston illustrated and described in the Spillman & Mooers patent 1,092,870, in structure, mode of operation, and results, with each of the pistons illustrated and described in each of the patents in suit? A. Considering the comparison of the Spillman & Mooers construction with that shown in the Gulick patent in suit, the two constructions are the same or similar with respect to the separation of the head portion of the piston and the skirt portion by horizontal slot between the head and the skirt. They are also the same in respect to the attachment of the head to the skirt, in

that both skirts are attached to the head proper, rather than to the ring flange of the head. They are also both similar in that the wrist pin bosses are mounted in webs rather than on the skirt or guide section proper. The means of attachment of these webs in the Gulick construction permits of rigidity in a vertical direction and of rigidity in one direction laterally. The Gulick webs, however, are flexible in the other lateral direction, which flexibility permits the opening and closing of a vertical slot in the skirt of the Gulick piston. These webs in the Gulick construction are designed to produce such flexibility. There is no vertical slot in the skirt or guide section of Spillman & Mooers, and the web construction joining the head and the skirt and supporting the wrist pin bosses does not provide for such flexibility. That is, the Spillman & Mooers construction is designed for rigidity rather than flexibility. There is a difference also in the attachment of the webs both to the head and to the skirt. In the Spillman & Mooers construction the head is attached to the skirt by means of an annular web in contact with the head, and the web extends nearly to the bottom of the skirt and attaches to the skirt in a horizontal plane. There is no attachment in the Spillman & Mooers between the junction of the webs near the bottom of the skirt and the top of the skirt itself. In so far as mode of operation is concerned, the two pistons function differently. The Spillman & Mooers piston is designed to operate without flexibility of the skirt. The intention is to keep the top of the head portion cool as a result of the poor heat conduction across the air gap at the horizontal slot. There is no provision for either cooling or flexibility at the bottom of the skirt in the Spillman & Mooers. The mode of operation of Gulick is dependent on the flexibility of the skirt. This flexibility is gained as the result of both the horizontal slotting and the vertical slotting, as has been described before. The result is also different. The Spillman & Mooers construction can not be fitted as closely in the cylinder as the Gulick construction.

With reference to the Jardine patent, there is very little in common even in construction with the Spillman & Mooers construction. In one of the Jardine constructions, as shown in Figs. 1 and 2, the head is attached to the guide section by means of webs directly attached to the head, but such webs more nearly correspond to the Gulick webs than to the Spillman & Mooers webs. In so

far as the constructions shown in Figs. 6 and 7 of the Jardine patent are concerned, there is little in common between Jardine and Spillman & Mooers. The Jardine construction is designed to compensate for extra expansion at the top of the skirt by utilizing several methods of compensation, including flexibility of the skirt and web. The mode of operation of the Jardine construction is therefore different from that of the Spillman & Mooers. In so far as result is concerned, the Jardine construction gives a different result from that of Spillman & Mooers, and when aluminum is used for the piston material it gives a superior result in so far as fitting is concerned.

There is very little in common in construction between Maynard and Spillman & Mooers. Maynard attaches the skirt portion to the flange portion of the head, and the operation at the top of the skirt is substantially the same as described for Jardine, which is different from that of Spillman & Mooers. The Maynard construction therefore has a different mode of operation from that of the Spillman & Mooers. In so far as result is concerned, the same as was said of Jardine can also be said of Maynard as compared with the Spillman & Mooers construction.

The difference of construction between that shown in the Mooers patent in suit and the Spillman & Mooers, is described at some length in the Mooers patent specification itself. The Mooers construction is a single walled body, whereas the Spillman & Mooers is double walled throughout the greater portion of the height of the piston; and the Mooers construction is lighter and it is simpler and capable of being manufactured in a permanent mold. The mode of operation is partially the same and partly different. The point of similarity is that of the separation of the head from the skirt by horizontal slots which will tend to keep the top of the skirt cooler than if the horizontal slots were not present. In so far as this cooling effect is concerned, it is similar to that attained in the Spillman & Mooers construction. In the Spillman & Mooers construction, however, there is no provision for distortion of the top of the skirt and there is no relief of the skirt section at the top where the need for clearance is greatest. The Spillman & Mooers construction provides relief of the guide section adjacent the connectors between the head and the skirt because these portions will become hotter than other parts of the

skirt. This extra temperature will cause extra expansion at those points, and as a result of the mechanical connection of the head and the skirt at those points distortion or mechanical expansion of the top of the skirt will also occur. The relief makes possible the distortion of the top of the skirt to compensate for the extra expansion at those points. This mode of operation is not disclosed in the Spillman & Mooers construction, nor is it inherent in the construction. It is disclosed in the Mooers construction and it is inherent in the construction as described. The result obtained in the two cases, I can't really give. The result so far as the successful operation of an aluminum alloy piston is concerned, I must consider as negative in both cases in so far as pistons as disclosed in the two patents are concerned. Neither of the constructions provide for the element of flexibility described in Gulick, Jardine, and Maynard, and apparently necessary for successful use of the aluminum alloy piston. The Spillman & Mooers construction, mode of operation, and results, I think, have very little in common with Schmiedeknecht.

Q. Will you compare this Exhibit EEE with the disclosure of the Spillman & Mooers patent and point out any differences you find between the two, if there are any?

The Master: That is the Spillman & Mooers and EEE?

Mr. Richey: Yes, sir, the half section is Spillman & Mooers.

A. I think Defendants' Exhibit EEE is a fair reproduction of the section shown in Fig. 3 of the Spillman & Mooers patent. The skirt sections in the exhibit are perhaps somewhat thinner than would be obtained by reproducing the Fig. 3 to scale, but nevertheless I would consider this a fair reproduction of the patent structure.

Q. Do you find at the top of the skirt in the patent a face which inclines inwardly and downwardly, which is not in Exhibit 3-E? A. Yes. No doubt put in by the machining operation.

Q. The purpose of that was to drive the oil into the interior of the piston, wasn't it? A. Yes.

Q. And in Exhibit EEE the bottom part of the skirt below the connector has been machined, hasn't it? A. Yes.

Q. That is not shown in the drawing of the patent, is it? A. Well, one could not say whether the finishing had been completed by machining or merely left as in the cast condition.

Q. Will you next compare the Defendants' Exhibit CCC in structure, mode of operation and results with pistons illustrated in each of the Gulick, Jardine, Maynard and Mooers patents in suit?

The Master: Is that the Chevrolet?

The Witness: Yes.

Mr. Bruninga: Chevrolet 4; the other one is Chevrolet 6.

A. Defendants' Exhibit CCC bears the same relation to the Gulick construction as was described for Defendants' Exhibit BBB, that is, the constructions are clearly different. The Gulick has the double-walled structure, web construction, bosses mounted in the web only and not attached directly to the skirt, whereas Defendants' Exhibit CCC is a single-walled construction, more along the lines in construction of the trunk type piston. In so far as mode of operation is concerned, however, Defendants' Exhibit CCC utilizes the flexibility attained by horizontal slotting between the head and the skirt, and vertical slotting on the skirt between the two bosses, and the vertical slot joining the horizontal slot. The mode of operation of Defendants' Exhibit CCC therefore is the same as the Gulick with respect to the flexibility gained by the co-operation of the horizontal and vertical slots properly placed. The flexibility is not gained in the degree that it is in Gulick, however. In so far as result is concerned, the Defendants' Exhibit CCC produces the same result as Gulick in so far as the successful result is achieved by the utilization of the co-operation of these slots to gain flexibility.

Q. Before you proceed, you have pointed out certain differences in structure. Will you point out what if any similarities there are in the structure between Exhibit CCC and the Gulick piston? A. The similarities lie essentially in the horizontal slot and the vertical slot co-operating to produce skirt flexibility in response to the cylinder wall pressure. One cannot say that the structure of Defendants' Exhibit CCC is similar to the structure of the Gulick patent.

Q. Now, will you proceed with the other patents in suit? A. The structure of Defendants' Exhibit CCC is

not specifically that shown in Jardine. It does, however, operate in a manner similar to that of Jardine, especially at the top portion of the skirt. There are the horizontal separation slots between the head and the skirt in Defendants' Exhibit CCC as well as in the Jardine construction. There is relief around the bosses in Defendants' Exhibit CCC the same as in the Jardine construction, considering for comparison purposes Figs. 6 and 7 of the Jardine patent. The skirt portion adjacent the bosses may be considered broadly the equivalent of the Jardine web construction in so far as mode of operation is concerned. The same analysis of the methods of compensating for the extra expansion at the top of the skirt in Exhibit CCC as applied to Jardine, with one of the bearing faces slotted only, can be made. That is, the compensation for extra expansion at the top of the skirt in Defendants' Exhibit CCC is made partly by flexibility of the skirt as the result of the co-operation of the horizontal and vertical slots, it is made partly by the distortion of the skirt as a result of the extra expansion across the bosses, and it is made partly by the mechanical distortion of the skirt as the result of cylinder wall pressure. These factors are aided by the rather extensive relief around the boss portions at the top of the skirt. In so far as mode of operation is concerned, therefore, Exhibit CCC functions approximately the same as Jardine when one bearing face only of Jardine is slotted with a vertical slot. In so far as the bottom of the skirt is concerned, Defendants' Exhibit CCC functions the same as Jardine from the standpoint of flexibility, provided only one of the Jardine bearing faces is cut through; but in so far as oil distribution is concerned, it doesn't function the same as the bottom of the Jardine skirt. In so far as result is concerned, I would expect a similar result to Jardine with somewhat better oil-pumping characteristics; that is, lower oil consumption.

What I have said with reference to Defendants' Exhibit CCC and Jardine, applies in so far as the top skirt section is concerned, to Maynard; and Defendants' Exhibit CCC is also similar to Maynard in construction at the bottom of the skirt. The detailed construction of Defendants' Exhibit CCC is somewhat different in the boss region as compared with the Maynard drawing, a portion of the skirt in Defendants' Exhibit CCC being generously relieved to be the equivalent of the Maynard web. In mode of operation, the mode of operation of

Defendants' Exhibit CCC with that equivalency in mind, is the same approximately as that of Maynard. Defendants' Exhibit CCC is perhaps an impairment of Maynard in so far as boss support is concerned, and probably also in so far as weight for a given strength is concerned.

Defendants' Exhibit CCC embodies the mode of operation and a construction which may be regarded as the Mooers construction or an equivalent of this construction. The head is joined to the skirt from the flange portion of the head at regions around the boss, as shown in Figs. 10 and 11 of the Mooers patent, and there is relief of the skirt or guide section in the region of such connectors as shown in the Mooers construction. The mode of operation of Defendants' Exhibit CCC in so far as the function of the horizontal slots and the connectors are concerned, is the same as that of Mooers. This is made possible by the co-operation of the connectors and the horizontal slot and the relief to compensate in a measure, at least, for the extra expansion of the skirt at the top. In so far as results is concerned, no doubt Defendants' Exhibit CCC would produce substantially the same result as Mooers in so far as the distortion feature is involved in compensating for extra clearance. Of course the piston, when it is completed, that is, Defendants' Exhibit CCC, would function much better than Mooers because of the addition of the flexing feature to compensate for extra expansion.

Q. When you and your associates were trying to make the Ricardo piston operate successfully, as you have testified, did you or any of your associates in that work as far as you know, know of the Gulick patent or the Gulick piston? A. I knew nothing about it and I never heard any of them mention it.

Q. Do you know of any metal of which internal combustion engine pistons are made or have been made which, employed in the construction of the piston illustrated in the drawings of the Gulick patent, would have webs that weren't flexible? A. No.

Q. State whether or not it would be possible in your opinion to make a piston out of any metal employed for making internal combustion engine pistons and conforming to the drawings of the Gulick patent, without having flexible webs? A. No, it would not be.

Q. Will you now take up the Franquist patent 1,153,902, about which you were asked in your cross examination, and compare the piston illustrated and de-

scribed therein in structure, mode of operation, and results, with the pistons illustrated and described in each of the patents in suit? A. In so far as the structure of the Franquist piston is concerned, it is quite different from that of Gulick. It is a single-walled structure, as contrasted with the double-walled structure of Gulick. And its distinctive essential from an ordinary piston is the skirt construction, more particularly the ribs designated 12, which are supposed subsequently to be grooved to produce grooves 13. Aside from these ribs and grooves and a somewhat unconventional construction of the head section proper, this piston is similar to a trunk type piston. The mode of operation of the Franquist piston is also different from that of the Gulick piston. Taking the drawing, Fig. 1, for reference, it seems clear that if this construction were made of aluminum alloy and mounted as shown, it would function only approximately the same as a trunk type aluminum alloy piston. There are two horizontal slots in the Franquist construction at the top of the skirt and in the bottom ring groove. These are on the thrust faces and join the upper ends of the vertical grooves. The sections around the bosses are relieved, according to the specification, from the top of this piston skirt to a point below the bosses. This relief amounts to .005" on a side. The construction contemplates circumferential contraction and expansion of the skirt by virtue of the closing of slots 13 in response to cylinder wall pressure, and the re-opening of such slots as a result of the elasticity or resiliency of the metal of which the piston is made. If the construction shown in Fig. 1 and mounted as in Fig. 1, is made of cast iron, the piston should function much as a trunk type cast iron piston would, with the relief hampered in its functioning because of the locking of the wrist pin on both ends. It is probable, however, that this construction in cast iron would function approximately the same as a cast iron trunk piston. On the other hand, if this piston were made of aluminum alloy, the piston would not function satisfactorily and would surely seize if mounted according to instructions given in the Franquist specification. This would result from the binding effect of the wrist pin, which is made of steel, and hence which will not expand as much as aluminum during the process of heating up of the motor. In fact the tendency would be for the wrist pin and its locks to pull the sides of the piston adjacent the slot farther away from the cylinder

walls and thereby expand the thrust faces. This of course would militate against successful functioning of the piston. But even if the wrist pin were mounted free at one end, or both ends, the piston could not be mounted in a cylinder as described in the specification and function properly. The grooves 13 are supposed to be sufficiently flexible to permit of circumferential contraction as the piston expands against the cylinder wall. These ribs are not sufficiently flexible to permit of the operation as contemplated and described in the specification. There is not sufficient circumferential flexibility to be utilized to compensate for the expansion.

As to mode of operation, if the Franquist piston should operate as described, the principle of compensation would be different from that of Gulick. The Gulick flexibility is gained by flexible webs and flexible skirt and co-operation between horizontal and vertical slots permitting the flexing of the skirt. This may be referred to as the cantilever principle. The Franquist principle may be referred to as the accordion principle. Therefore the mode of operation of the Gulick construction is different from that of the Franquist construction. In so far as result is concerned, the Gulick construction is capable of compensating for the extra expansion of aluminum alloy, and the Franquist construction, as given, is not so capable, according to my belief.

Q. Will you now take up the Franquist patent with the next patent in suit, if you have finished with the Gulick? A. The Franquist construction is not like the Jardine construction and is not designed to function like the Jardine construction. The vertical ribs and grooves in the Franquist construction are not the equivalent of the vertical slots of the Jardine construction. In so far as mode of operation is concerned, there is a similarity, assuming something which is not shown in the Franquist assembly, that is, assuming that the wrist pin is mounted freely, the Franquist construction at the top of the skirt will operate in so far as mechanical distortion, somewhat similar to Jardine. The allowance, however, in the Franquist is not sufficient to take care of the expansion at the top of the skirt when aluminum alloy is used. He calls in his specification for close fitting of the piston when the motor is cold, with the exception that there is .005 relief over the bosses extending to the top of the skirt and to a point somewhat below the bosses on the sections 14 in the Franquist drawing. Assuming that

those sections 14 occupied approximately half of the circumference, that would be equivalent to about .005 clearance at the top of the skirt. That clearance could only be made available after cylinder wall pressure had expanded the two bosses to a certain extent; so that from that standpoint the Franquist construction apparently would only function up to a total compensation for clearance of .005" on the average diameter of the piston, assuming a tight or snug fit when the motor is cold. That would not be sufficient in aluminum alloy, whereas the Jardine construction shows adequate compensation in that regard. But the piston would have no clearance at the bottom of the skirt, that is, the Franquist piston; therefore all of the expansion must be taken care of by the circumferential flexing, by the flexing of the ribs or grooves in the Franquist piston. To my mind that would not be possible with this construction, and hence the Franquist construction would fail to operate properly in a motor at all. So far as the result is concerned, Jardine obtains a result and Franquist does not.

What has been said with reference to Jardine applies also to Maynard, that is, the construction of the Maynard piston is different from that of Franquist; its mode of operation is different; and its result is different.

With respect to Mooers, the Franquist construction is supposed to be a flexible one in so far as the skirt is concerned, whereas Mooers is not. The construction of the skirt sections in Mooers and Franquist are therefore different. Franquist utilizes horizontal slotting, as does Mooers, but the effectiveness of the horizontal slotting in the Mooers construction is made possible by proper relief and also by allowing the horizontal slot to act as an insulator of heat, so that the skirt will not become as hot in portions separated from the head by the air gap, as it will in other portions. In the Franquist construction there is a ring put right over the horizontal slot. This ring is pushed tightly against the head portion during the down stroke and tightly against the skirt portion during the upstroke of the piston, and the ring of course gets hot and it has an opportunity therefore to impart its heat to the top of the piston skirt, which is not true of the construction shown in Mooers. Even so, the air gap in Franquist would operate to partly reduce the amount of heat that would pass from the head to the skirt in the region of the slot; how much I don't know, whether it would be 50 per cent or 75 per cent, but at

any rate the ring is capable of imparting a considerable amount of heat to the top of the skirt. So that at any rate the slots in Franquist would not be as effective in producing the thermal distortion as in Mooers. To that extent, whereas the Franquist construction might operate to a degree like the Mooers, it does not gain the full advantage of the horizontal slotting in so far as that particular feature is concerned. Apparently the horizontal slot is not designed to serve as a heat insulator in the Franquist piston. It was designed to help with the flexing of the skirt portion. Had it been designed to act as a heat insulator, the ring would not have been put over it. Again, in so far as result is concerned, we may say that neither of these pistons achieved the final success, either the Franquist or the Mooers; but the Mooers principle of compensation for extra expansion is now utilized in a good many constructions substantially as described by Mooers, whereas the Franquist piston principle, so far as I know, is not used at all in the pistons at the present time. I guess there is no particular relationship between Schmiedeknecht and Franquist so far as I can see.

Q. You were asked during cross examination regarding taper grinding. Can you state whether or not the taper grinding of pistons in your opinion contributed to the success of the aluminum piston? A. The taper grinding was used even on the old trunk type aluminum pistons, that is, the clearance at the top of the skirt was made greater than the clearance at the bottom of the skirt. While this was helpful in the trunk type pistons, it was not sufficiently helpful to solve the problem.

Q. Now, will you state whether or not the pistons made in accordance with the patents in suit have been used without taper grinding? A. Yes, they have.

Q. To what extent? A. Very substantial.

Q. And with what success? A. With very great success.

Q. Now, during your cross examination you were asked about what my brother spoke of as the keystone shape of the relief at the bosses. Will you state whether, or not that has contributed any to the success of these aluminum pistons? A. It has contributed in a minor degree to the success of the aluminum pistons in more recent years. It was not a controlling factor, however, in the solution of the difficulties, and it is not a necessary feature for the success of the aluminum alloy piston.

Q. You said that the engineers of the Aluminum Castings Company, including yourself and certain British engineers, were struggling to solve the problems solved by the patents in suit. Do you know whether anyone else was struggling with this problem during the time prior to the final solution of it by the patents in suit? A. Yes.

Q. Will you name in a general way such as you know, were known to you to be working on this problem during that time? A. This problem of taking care of the excess expansion of aluminum pistons was acute even in 1916 at the time I was working actively with the Aluminum Castings Company. Beginning in 1916 I personally had meetings and conferences with a good many automotive engineers in the United States who were working toward a solution of this problem. The problem was recognized throughout the automotive industry. I recall meetings that I had with Col. Vincent, chief automotive engineer of Packard Motor Car Company, D. McCall White, chief automotive engineer of Cadillac, Mr. Ferguson, chief automotive engineer of Pierce-Arrow, and several others, during the period 1916 to 1919. From my own knowledge I can say that the automotive industry was alive to this problem and that the clearance problem was the one which needed solution most in order to make practical the utilization of aluminum alloy pistons in pleasure cars.

Q. Who was this Mr. Ferguson to whom you referred? A. He was chief engineer of the Pierce-Arrow Motor Car Company.

Q. Now, you were asked during your cross examination whether or not you knew the piston of the Franquist patent had been used commercially. Do you know whether or not any of the licensees of the Cleveland Trust Company have ever manufactured a piston like that shown in the Franquist patent? A. Not that I know of.

Q. Has anyone to your knowledge manufactured it since the Franquist patent expired? A. Not that I know of.

Q. You have stated that in your opinion the piston of the Franquist patent and that of the patents in suit operate differently. Is this opinion based upon any tests or observations you have made of the pistons themselves? A. Yes, it is.

Q. Will you state briefly what those observations were and what the tests were? A. By applying pressure on two opposite sides of the skirt of the piston—

Q. You can use this Exhibit 3-Q in answering the question, if you wish. A. —by applying pressure on opposite sides of the skirt of the piston, one can of course cause its diameter to decrease. If this is done with the Gulick piston, Plaintiffs' Exhibit 20, it will be found that the increase in diameter in a direction right angles to that at which the pressure was applied is negligible. For example, the Gulick piston can be compressed across the bosses by mechanically applied force, so that its diameter in that direction is reduced .010". It will be found that the diameter at right angles has not changed appreciably. This means that the clearance will have been greater by approximately .005" under such circumstances. I have run such tests on the Gulick piston. I have also run tests on a piston similar to that of the drawings of the Franquist patent referred to earlier, and find that when the diameter of the piston at the bottom of the skirt is compressed .010" in one direction, there is an expansion in a direction at right angles to the direction of applied stress equivalent to some 75 or 80% of the contraction at the point stressed. I have run similar tests on pistons which did not have the vertical slot completed, for example of the type of Plaintiffs' Exhibit 1 prior to the completion of the slot, and found that it behaves quite similarly to the Franquist, except that the stress required to produce a given amount of deformation was less in the Plaintiffs' Exhibit 1 type of piston. The expansion in the direction opposite to that of the applied stress was comparable in magnitude to that in the Franquist type piston. After the completion of the slots in the Plaintiffs' Exhibit 1 type of piston the behavior is more like that of the Gulick construction and less like that of the Franquist construction. The Franquist skirt therefore behaves very much like the skirt of the trunk type piston and not like the skirt of the Gulick type piston.

(Adjournment taken to 1:30 P. M.)

(1:30 P. M., the hearing was resumed, Mr. McCoy also being present.)

Q. Doctor, will you take the can opener, Exhibit 3-I, and demonstrate the piston 3-Q which the defendant produced as a Franquist piston, and Plaintiffs' Exhibit 1, with this can opener, showing the Court that the one is flexible, and what is the condition of the other one? A. I have in one hand the testing device, Defendants' Exhibit 3-I, and in the other hand I have piston, Plaintiffs' Exhibit 1. I apply very mild pressure on the handles of

the testing device, and the closing of the vertical slot can be readily seen. That is at the bottom of the skirt of the piston. At the top of the skirt I also apply mild pressure, and the opening and closing of the slot can be readily seen with the unaided eye. I now have in my left hand the Franquist piston, Defendant's Exhibit 3-Q. Applying the testing device to the bottom of the skirt, I apply mild pressure and no closing of the slots can be seen with the unaided eye. I apply pressure to the full extent of my grip, and perhaps there is a little suggestion of a motion, but it is doubtful, and there is not very much closing of the slot, and clearly insufficient to accommodate the excess of expansion when the piston is operated in a motor car. Applying the same test to the top of the skirt with mild pressure such as used in Plaintiffs' Exhibit 1, no motion can be seen, and with pressure to the full extent of my grip, the structure behaves substantially as a rigid body.

Q. How did the pressures that you applied compare with those encountered in piston use? A. Plaintiffs' Exhibit 1 is a commercial piston, and the flexibility in the skirt of Plaintiffs' Exhibit 1 is known to be proper for compensation for excess expansion of the aluminum alloy. If the flexibility of Plaintiffs' Exhibit 1 is proper for motor car operation, then it would appear that the flexibility of the Franquist type piston must be on the order of, say, not more than about a tenth of that of Plaintiffs' Exhibit 1. That is a difference of an order of magnitude insofar as flexibility is concerned.

Mr. Richey: That is the end of the direct examination.

RE-CROSS EXAMINATION by Mr. Bruninga.

Q. Doctor, you said in answer to one of Mr. Richey's questions that the Kant-Skore case in Cincinnati was tried, I think you said that, didn't you? A. Yes.

Q. You were there during the trial of the case? A. Yes.

Q. It was not tried to conclusion, was it? A. There was no decision rendered by the Court.

Q. There was a settlement, wasn't there? A. Yes.

Q. Do you know the terms of that settlement? A. Generally, yes.

Q. What were the terms of the settlement? A. I think the Kant-Skore Company agreed to the validity of the patents in suit and that they had been infringed,

and they also took a license under those patents which were in suit.

Q. Those molding patents—those Banberg patents, Norton and Parkhurst patents? A. Yes.

Q. And a lot of other patents? A. Yes.

Q. In fact all of the molding patents the Aluminum Company of America had? A. All of the molding patents, I think, relating to pistons.

Q. Did the Kant-Skore Company come to you or did the Aluminum Company go to them in the matter of taking license under the patents, or was that made a part of the settlement? A. I don't know.

Q. One cent royalty was paid per piston, isn't that right? A. That was the agreement of the license, as I recall.

Q. What were pistons selling for in those days, 1923? A. It differed for different size and weight pistons, of course, but as I recall it, average price of a piston at that time would be somewhere around 63¢.

Q. The margin of profit was much greater than the one cent, wasn't it?

Mr. Richey: I object to this as immaterial. What difference does it make to the issues of this case what the margin of profit was?

Mr. Bruninga: What difference does it make if the Kant-Skore case was tried?

Mr. Richey: That is the reason why I think you were wrong in going into it in the first place.

Mr. Bruninga: You know this witness was asked in cross examination whether the case was tried or he knew about it?

Mr. Richey: Yes, but that refers to what was asked by you on cross examination.

The Master: He may answer.

A. I don't know what the margin of profit was.

Q. But it was more than one cent per piston? A. I assume it must have been.

Q. It was at least ten cents a piston in those days?

A. I don't know.

Q. Do you consider that a good fat royalty, one cent a piston?

Mr. Richey: I object to that as immaterial.

The Master: He may answer; same ruling.

A. I don't know what you mean by "good patent royalty." I think it is a royalty in line with a good many royalties that are paid on patents throughout the country.

Q. You also testified on re-direct examination that the split piston patents made possible the commercialization of the piston by the permanent molding process; did I understand you correctly? A. Yes.

Q. Isn't it a fact that both before Judge Faris and Judge Kerrigan you took the position that the molding process made possible the utilization of the split skirt? A. Yes, those two things go together in the piston art. That is the fine qualities of metal attained by the permanent molding process, in the selection of alloys and so forth, which really make possible the use of aluminum in considerable quantities as a piston material. Now, the slotting of the skirt is essential for the development of the aluminum piston business for pleasure car purposes, and that in turn is dependent on the qualities of metal attained in the permanent mold product.

Q. You said that in 1916, just one year after the permanent molding process came into use in this country, as I believe you testified before both Judge Faris and Judge Kerrigan, the situation was acute on account of no compensation for expansion at that time? A. That is correct.

Q. You did not tell either Judge Faris or Judge Kerrigan that, did you?

Mr. Richey: I object because it is immaterial. That wasn't in issue in this case.

The Master: He may answer.

A. I don't recall that I did. Had I been asked I would have. I am saying now, however, that it was not as acute then as it might be today, because the matter of noise was not given the weight in 1916 that it is in 1933, nor perhaps is the matter of oil pumping.

Q. I believe you stated on re-direct examination that the clearance problem needed solution in order to make the aluminum alloy piston successful in pleasure cars, and you had reference to as early as 1916, '17, '18 and '19, didn't you? A. In order to make it more practical. Didn't I say "practical"?

Q. Well, I would take that as a modification. A. There was so much trouble with the clearance problem that concerns like the Packard Motor Car Company would use aluminum alloy pistons for a time, gaining the advantages of high heat conductivity and lightness, only to turn back to iron a little later to get rid of the slapping

or noise of it. And then they would turn back again a little later to aluminum in order to get back the advantages of lightness and high heat conductivity. That is the type of difficulty that the aluminum alloy piston had in the earlier days.

Q. Did you tell Judge Faris or Judge Kerrigan that when the molding patents were in suit? A. I don't know that I did. I think it was mentioned, however, in the suit that there were these switches back and forth from aluminum to iron and iron to aluminum. I don't think I was asked about anything like that, I don't know.

Q. There were statements all about it as prior efforts and failures by both you and Mr. Richey. A. No, these things happened after the molding patents were taken out—after the process development was made.

Q. But you told both Judge Faris and Judge Kerrigan that the pistons were found very successful in trucks, in airplanes and by the Beo Motor Company without splitting of any skirt? A. That is correct.

Mr. Richey: Is your previous answer correct as it relates to the molding patents?

(Previous question and answer read by reporter.)

The Witness: Yes, the main molding patents, I think issued in 1919. What I meant was these things happened after the molding process had been developed and after the permanent molded piston had been put on the market.

Q. That was in 1915? A. Yes.

Q. Now, you said the flexibility of the piston was solved in 1920. By that you mean Jardine and Maynard? A. Well, the first real solution that I have knowledge of was Jardine.

Q. And the next one Maynard? A. Yes.

Q. Now, you said on re-direct examination that you heard of various means and ways to take care of expansion. What were they? A. I don't exactly recall that part of the testimony, but one means was taper grinding; another means was the horizontal slotting.

Q. Like in the Menara patent? A. Well, that was something on that order, yes. I don't know whether this testimony that you refer to has to do with the Ricardo tests or whether it has to do generally.

Q. No, it didn't. You just made the statement that you heard of various ways to take care of expansion and

then you said a number of these were tried out and a number dismissed? A. Yes. Well, another was the composite type of piston, that is, with an aluminum head and a cast iron skirt.

Q. And that was a failure? A. Well, that was a failure from the practical standpoint, yes.

Q. It was used in the Marmon car, wasn't it, for a while? A. It was.

Q. In what year? A. Oh, I think it was used as late as 1921, possibly as late as 1922; but the piston was expensive and heavy and it was also difficult to hold the two parts together in operation.

Q. It is still used in some of the Nash cars today, isn't it? A. I don't know of any that use it, but that was one of the means employed, at any rate, to solve this expansion difficulty. Then another means was the slotting of the top of the skirt, and I distinctly recall the Franklin Motor Car Company using that as one means of overcoming the difficulty.

Q. You mean the top? A. Oh, I mean slotting the bottom of the skirt.

Q. In other words the running of a single slot from the bottom of the skirt to near the ring lands between the wrist pin bosses, in that region between the wrist pin bosses? A. The particular slots I have in mind ran about half way around the skirt, and four slots were used from the bottom of the skirt extending, say, about half-way up the skirt.

(Short recess taken.)

Q. Is Defendants' deposition Exhibit B one of these Franklin pistons that you have referred to? A. Yes.

Q. Do you remember what year that was that this piston was used in the Franklin car? A. I would have to say from my recollection, but as I recall it it was the summer of 1916.

Q. Do you know how long that was used in the Franklin car? A. No, I don't know. I know they continued to put these slots in.

Q. Is that one of those that you tried out and dismissed? A. Yes, this is one of the types I had in mind as having been tried out and having failed to solve the problem.

Q. The bottom of that skirt is, however, very flexible? A. Yes.

Q. Now, can you enumerate another one of those pistons that you have heard about or tried out or dismissed,

and by you, I mean your company, which I believe was the Aluminum Manufactures? A. It was Aluminum Castings Company between 1915 and 1919, and Aluminum Manufactures, Incorporation, after about 1919. Another one was a piston of the two-walled type, known as the integral aluminum piston, however, as distinguished from a composite type of piston. It was sought to effect a reduction in clearance by keeping the skirt cool. This also failed to function properly.

Q. And what was the construction of that piston? A. It was a double-walled aluminum piston with the bosses held on the inside wall and not directly attached to the skirt. The piston was cast in a permanent mold with a flange at the bottom of the skirt. The boss-containing portion was reduced in diameter so that it was considerably smaller than the outside diameter of the piston. The flange was then spun to produce the skirt proper, and the effect was one of having the head and skirt separated by a complete horizontal slot.

Q. And whose piston was that? A. It was the Aluminum Castings Company's own piston.

Q. Was Elmer Long's piston included in any of those you heard about and tried out and dismissed? A. Not to my personal knowledge.

Q. You never heard about the Long piston at all in those days before Mr. Jardine conceived his piston? A. As I recall it, not before Mr. Jardine's piston was developed.

Q. But you did hear about the Long piston? A. Later, yes.

Q. Do you remember what year that was? A. No, I couldn't say.

Q. What car did you see it in? A. Why, I didn't see it in any car. I saw some pistons around the plant of the Aluminum Manufactures, Incorporated, in Cleveland, for the Franklin car, as I recall it.

Q. And that was about the year 1919 or '20? A. I can't say from my recollection.

Q. But your company never gave that a trial in the laboratory or otherwise? A. Well, I don't know about that.

Q. Do you remember the construction you saw at that time? A. No, I wouldn't be able to identify it.

Q. Of the pistons about which you heard or tried out or dismissed, was there any piston of Albert Spillman of North Tonawanda, New York? A. Not that I recall.

Q. Well, you saw that piston later on at the Kant-Skore trial, didn't you? A. Yes.

Q. And that is the first time you saw it? A. No, I had seen it a little time before that, but as I recall it only a few months before the Kant-Skore trial.

Q. You didn't try that out at all? A. Not that I recall.

Q. Well, you were interested in finding out what was being put on the market, weren't you? A. Yes.

Q. Didn't you go to Europe about 1919 and 1920? A. I went to Europe in 1919.

Q. In part investigating the piston situation? A. I did when I was in Europe, yes.

Q. You say that was 1919? A. Yes, that was 1919.

Q. And you investigated the Ricardo piston at that time? A. I did.

Q. And did you investigate the Rolls-Royce piston at that time? A. No, not directly. That is, I didn't see the Rolls engineers, but I did see, I think, some of the pistons being manufactured in the rough.

Q. Can you tell me what type pistons these were?

Mr. Richey: I object to this as immaterial. Any use abroad would be immaterial so far as American patents are concerned.

Mr. Bruninga: Oh, no, this witness has said—

The Master: He was familiar with the art.

Mr. Richey: Well, the art don't include prior uses abroad. That is not a statutory defense to a United States patent. It has got to be in this country.

Mr. Bruninga: That proposition comes up every once in a while, your Honor, and if this witness went over to Europe and he saw a piston in use over there and communicated it over here—

The Master: I think he may answer that question.

Mr. Richey: Your Honor, I would like also to object to it on the ground he is going into prior art on our prima facie case and makes the witness his own, and that objection should apply to all the questions regarding the prior art.

Mr. Bruninga: Regarding that statement that I make the witness my own, I have never heard of such a proposition, except from this counsel in a number of cases.

Mr. Richey: It is a rule in Federal Court—

The Master: The same ruling. You may proceed.

A. All I saw of the Rolle-Royce, as I remember it, was just a rough casting, and this was an ordinary trunk type piston casting, as near as I can recall it.

Q. You didn't see Mr. Ernest Hyde, one of the engineers of the Rolle-Royce, then, did you? A. No.

Q. Now, those pistons that you heard of or that you tried out or that you dismissed, did they include the Stephen D. Hartog piston? A. I don't know. I don't recall that piston.

Q. You don't recall it, then, by name? A. No.

Q. Do you recall the piston shown in the United States patent 1,942,022?

Mr. Richey: Same objection.

The Master: Same ruling.

A. I recall the drawing, is all. I don't recall having seen a piston like that.

Q. That isn't, then, one of the pistons that was tried out? A. I have no knowledge that it was tried out, or that it wasn't.

Q. Now, you say you never heard of the Gulick piston until when? A. Until I was asked to give testimony in a deposition in an interference case on behalf of Gulick.

Q. Around 1926 or 1927? A. I don't recall that date.

Q. Was that testimony given in behalf of Gulick or Cleveland Trust Company? A. Well, on behalf of the Gulick application for the Cleveland Trust Company.

Q. Now, you have said on re-direct that the war minimized the activity in aluminum pistons. It was really not until 1919 that this company really proceeded with the attempted solution of this problem? A. No, they were working practically on it from the first that I can remember in the Aluminum Castings Company.

Mr. Richey: I don't believe he said that. He said minimized the activities between the nations. I don't think he said what you said there.

Mr. Bruninga: Well, the record will show what he said. That is what I understood him; if I am wrong it can be corrected.

Q. However, what do you say, did it minimize the activities everywhere or the activities of your company?

A. I think what I said was it minimized the international exchange of information, so that there was quite a period when we knew very little about what was going on abroad; but the activities of the Aluminum Castings Company were continuous on this problem, from my knowledge, since late 1915 or early 1916.

Q. It was not until 1920 that anything was produced of sufficient importance to enable its use successfully in a motor car, pleasure car? A. It was about that time, according to my personal recollection that the Jardine solution was made, and that as I said before, was because it has proven worthy with reference to this particular phase of the aluminum piston problem.

Q. You are referring now to the efforts made by your company and not perhaps others? A. No, I had in mind the efforts made by others as well. If a real solution of this problem had been found abroad, or outside of the Aluminum Castings Company, the chances are very great that we would have known about it in connection with our work and our activities. That is, what I may call a practical solution of the problem.

Q. Well, you know, don't you, or had reason to believe, that the Long piston was in use in the Franklin cars in 1919? A. Well, I don't happen to recollect that, but if it is a fact I would still say the same as I just did: that is, the Long piston was really no solution of this problem.

Q. And you are familiar with the Long piston? A. I am familiar with one type of what is known as the Long piston, yes.

Q. And that is the type that is in evidence here that is marked for identification as Defendants' Exhibit EFF? A. Yes.

Mr. Richey: We make the same objections.
The Master: Same ruling.

Q. And you personally consider that that is not a solution of the problem? A. That is correct.

Q. Why? A. Well, in the first place the piston is in part double-walled; it is relatively heavy; it is expensive to cast and it requires a greater clearance on the thrust faces than the pistons now, the single-walled pistons that have solved this difficulty.

Q. Well, you know, don't you, that suit was filed against Mr. Long's company in Detroit on account of infringement of some of the patents in suit?

Mr. Richey: I object to that. The record is the best evidence of that.

The Master: He may answer.

A. No, I have no knowledge on that.

Q. Your main objection really it is a double-walled construction? A. Well, I don't think it is a practical solution of the problem, no.

Q. Have you ever met Mr. Long? A. No, not that I recall, at least.

Q. Now, with reference to the Ricardo piston about which you have testified on cross examination and on re-direct, have you any samples of that piston? A. Not here. I think I could find a sample.

Q. You mean a sample of just one Ricardo construction, I mean as to details? A. I don't know what samples might be available. There may be more than one.

Q. Well, you tried out various constructions, didn't you? A. Tried out pistons for different motors.

Q. Were they all constructed the same as to details? I don't mean as to thicknesses but as to arrangement of webs? A. No, I think not. I think there is a horizontal web in the drawing of the Ricardo patent that was left out, yes, C-3, in Ricardo United States patent 1,294,833, that was left out, at least on one of the constructions as I recall it.

Q. Well, the webs C weren't made as heavy as shown in the patent in all of the constructions, were they, I mean relatively? A. In the pistons made up under the direction of Mr. Parnell and Mr. Pomeroy and Mr. Halford, I think the sections were quite comparable to those shown in the Ricardo patent. There were some pistons made up later with thinner webs and also the Jardine construction was made, which has considerably thinner webs than those shown in the Ricardo patent. The web and head construction, however, was different in the Jardine pistons, which were made in the permanent molds.

Q. A structure without the web C which you have referred to, is that illustrated in Fig. 2 of "The Automobile Engineer" of October, 1918, isn't that right?

Mr. Richey: I make the same objection. Is that alleged in the answer?

Mr. Bruninga: No, it is not set up in the answer. I am trying to find out what this company

did with the Ricardo pistons, about which he has testified so at length.

Mr. Richey: I object further on the ground that the publication is not set up in the answer.

The Master: Same ruling.

A. Yea, that is the type of construction to which I had reference.

Q. How about the construction shown in Fig. 4? Did you try that out also, Fig. 4 on the same page, page 274? A. (After examining same) No, I don't recall that that was tried out. That is for a very large bore piston, seven inches in diameter. We didn't test out anything as large as that.

Q. You didn't test out anything in which the webs weren't parallel but at an angle, as shown in Fig. 4? A. Oh, I think we very likely tested structures where the webs were at an angle, but I didn't recall testing anything just as that construction. If it is the angularity of the webs you have in mind, I think perhaps we did test pistons with angular webs.

Mr. Bruninga: The magazine shown to the witness is marked for identification as Defendants' Exhibit 2-B.

Q. You say none of these pistons ever went into use? A. In the United States?

Q. Yea. A. Well, so far as I know they didn't.

Q. Did they go into use in Europe at all? A. That is my understanding, that they did to a small extent.

Q. They are still used today in Europe, are they not? A. Not according to my information.

Q. But they actually did go into commercial use, then, whether here or in Europe? A. It was so reported, but I don't know of my own knowledge.

Q. Well, you met Mr. Harry F. Ricardo, didn't you? A. No.

Q. Well, you know he is an eminent engineer, don't you? A. Yea.

Q. You won't dispute his statement if he said it did go into wide use? A. I don't know.

Mr. Richey: I object to that as immaterial, ask for hearsay, and further object to those questions regarding this piston as immaterial.

The Master: He has already answered.

A. (Continued) I may say in that regard trunk type pistons went into use also. I have also testified

that this Ricardo type piston behaved in a motor a good deal like a trunk type piston. So that the fact that it may be used, in, I think, one which I would not dispute, at any rate it is a question as to how successfully it can be used.

Q. The double-walled type that you referred to just a little while ago as having been made by your company or brought out by your company, was that split in any way? A. No, not in a vertical direction. The head, however, was separated from the skirt proper around the entire periphery of the piston.

Q. Where did that piston get too hot, at the top or at the bottom? A. Which one?

Q. The piston that you have just talked about, the double-walled type? A. Well, it got too hot particularly at the top of the skirt, but I presume that that whole piston was too hot for proper operation in the cast iron cylinder barrel.

Q. Now, you referred to Mr. Lawrence Pomeroy as one of the engineers that was sent over here. He was sent over here, or rather, he actually did something else but stand around; he worked on this thing, the Ricardo piston here, didn't he? A. Yes, his advice was given to the Ricardo representative and also to the Aluminum Manufacturers, Incorporated, or the Aluminum Castings Company.

Q. He contributed something to the Ricardo piston, didn't he? A. Well, I don't know that he contributed anything; he worked on it. He tried out these Ricardo pistons in a motor that he was developing, and discarded them, and then he had a scheme of his own for compensating for the excessive expansion, as I remember it.

Q. What was his scheme? A. He sought to make the webs flexible in the direction of the thrust, by a series of slots in the webs themselves.

Q. Like that shown in Pomeroy patent 1,459,073? A. Yes.

Q. Was that tried out? A. Yes, that was tried.

Q. And that was also a failure? A. It was. Yes, it was not a satisfactory solution of the problem, at any rate.

Q. Didn't that take care of the expansion to some extent? A. Yes, but it produced, as I recall it, a permanent set too easily in the flexed portion.

Q. Were those pistons that you tried out, Ricardo and Pomeroy pistons, made in permanent molds? A.

Some were made in permanent molds and some were made in sand.

Q. The sand casting was no good whatsoever, was it? A. Well, it didn't have the wearing qualities that we desired, but it was sufficient to test the expansion characteristics. The expansion of the sand casting is the same as that of a permanent mold casting when the two are heated to the same temperature, but you wouldn't expect even a half decent device in the sand mold.

Q. Because of your theory of the utility of casting in permanent molds? A. Well, I wouldn't expect a salable device, I wouldn't have at that time, at any rate.

Q. And a construction like that shown in the Ricardo patent, 1,294,833, and as shown in the Pomerooy patent 1,493,073, was actually cast in permanent molds, then?

A. Yes, those were cast in permanent molds, that is, pistons of such construction.

Q. Didn't the overhanging slipper edges prevent you from withdrawing the outside mold part? A. Yes, in that particular construction that is true. And also there was a problem at the head section, but that was taken care of by a couple of separate inserts which were taken out after the piston was removed.

Q. But both of those were actually cast in permanent molds? A. Yes.

Q. Even when they had the overhang? A. Well, the overhangs were eliminated in the permanent mold castings, but the direct connection of the head and webs was made possible by the use of inserts in the mold, as previously mentioned.

Q. Who suggested the elimination of the overhangs? A. I have no idea.

Q. Do you know whether any of the British engineers suggested it? A. I haven't any knowledge on that subject at all.

Q. Now, you said a number of expedients were tried out to make the Ricardo piston satisfactory. What expedients were they? A. Well, I can't say from my own recollection now as to just all the things that were tried, but I do recall very clearly that the men whose names I have previously mentioned were trying in every way that they could to make this piston successful, and that I know involved the changes in actual clearance, that is, various means of fitting pistons, and I also know that the pistons when they came out of the motors, especially when the fitting was close or close enough to avoid noise,

had scoring on the bearing faces opposite the ends of the webs, and change of clearance in these portions, as I recall it, was tried to get away from that difficulty; but nothing that could be suggested by the British engineers or our own engineers was sufficient, or offered sufficient improvement to warrant the approval of the Ricardo piston.

Q. You mentioned Mr. Pomeroy as having suggested an expedient. What other than as shown in his patent did he suggest? A. Well, Mr. Pomeroy's attempted solution of this problem with the Ricardo piston, as I recall it, came quite a bit later. That is, I think that the piston was put into discard, so to speak, before this suggestion of Mr. Pomeroy's, although I can't say positively as to that.

Q. Did Mr. Pomeroy suggest any other than that? A. Well, not specifically as I recall it.

Q. Do you know of any expedient that Mr. Parnell suggested? A. Not specific, no. I can't name the suggestions that any particular individual offered in this case.

Q. And that is true of Messrs. Blank, Wesley, Carpenter and Allyn? A. Yes.

Q. How about yourself; you know what you suggested? A. Yes, I know that I had nothing to suggest after hearing what the others had tried.

(Short recess taken.)

Q. I understood you to say, Dr. Jeffries, that these Ricardo pistons scored opposite the webs, is that right? A. Yes.

Q. That is about on a line with the webs? A. That is correct.

Q. Is that one of the purposes of Pomeroy's arrangement, to prevent that scoring? A. Well, it was that and also to stop slapping. In other words, to try to make a Ricardo piston function in the motor so that it wouldn't stick or it wouldn't slap.

Q. Do you know who owns the Ricardo patent now? A. Why, I don't know, but I suppose it belongs to the Cleveland Trust Company, in this trust.

Q. How about the Pomeroy patent?

Mr. Richey: We state that the Cleveland Trust Company doesn't own the Ricardo patent.

Mr. Branning: The Pomeroy patent is owned by the Cleveland Trust Company?

Mr. McCoy: Yes, now. The Pomeroy patent 1,490,073.

Mr. Bruninga: Is that also true of the Hartog 1,842,022, previously referred to?

Mr. McCoy: Yes, that is owned by the Cleveland Trust Company.

Q. Can you explain why that scoring took place in the Ricardo patent and does not take place in the Jardine patent opposite the web; that is, I understand the surfaces of the slippers directly in line with the webs were the ones which were scored? A. Yes, in general, or briefly, the Ricardo construction is a strong, rigid, non-flexible box-type structure, and when the webs heat up from the combustion of gases in the motor, they expand, and there is no place for the metal to go readily, except to materially increase the length of those webs, so as the length increases pressure against the cylinder barrel increases, eventually scoring results. Whereas in Jardine you have the structure made so that it will be flexible and you have slots so as to permit flexing.

Q. In other words in the Ricardo construction where there is no slot here, the outward pressure due to the expansion of the web, will cause the surface of the slipper to move right against the slipper and cause scoring; is that right? A. Yes.

Q. And that is not true in the Jardine patent structure because these webs can flex down? A. That is correct; that is, it is not so of the Jardine construction.

Q. That is the reason there is no scoring in Jardine and there is scoring in the Ricardo, because these webs can flex and move down? A. Yes.

Q. And it is your opinion, then, in the Maynard patent that also takes place; that these webs can flex, and the part corresponding to the web 25 of Jardine being able to flex, the surface can move downwardly? A. Yes.

The Master: Move inwardly!

The Witness: Move inwardly in Maynard's.

Q. And it is your opinion that is true even though the web may be a quarter of an inch long or as shown as, for instance shown in the Maynard patent, and as shown in Exhibits 1 and 17? A. Yes, it is true of the construction of the Maynard patent. I mentioned, I think, the several factors contributing to the compensation for the excessive expansion in Maynard, of which flexibility is one, and a most important one.

Q. And if the keystone relief on Exhibit 1, for instance, were filled in so as to fill the web, flexing would take place of that short little web now together, the same as in the Jardine patent? A. Well, if there were no flexing in the web, there would be flexing in the skirt.

Q. But the flexing of the skirt itself would take care of any direct pressure due to elongation of the web irrespective of whether the web was flexible or not? A. It might not.

Q. As a matter of fact it is necessary, therefore, to cut that relief in the pistons like Exhibits 1 and 17 to take care of that very condition? A. Well, it is found desirable to do that.

Q. Well, it is done in every piston that is made like Exhibits 1 and 17 today? A. I think so. I think that is the practice in most of the pistons today, at any rate.

Q. And the relief must be the greatest at the top and can decrease to practically zero at the bottom; isn't that right? A. Well, the relief need not be greater at the top than at the bottom of the relief portion, but it is desirable to have as much bearing area as possible, and to gain any bearing area the wedge or keystone shape, as you have termed it, is desirable, with that web construction shown in Maynard.

Q. And it is your opinion, then, that Figs. 1 and 2 of the Maynard patent show this relief as in Exhibits 1 and 17? A. They do not show the relief in just the same way as it is in Exhibits 1 and 17 but they do show the relief extending past the ends of the horizontal slots.

Q. As a matter of fact there is no relief, that is a depression, on the surface of the skirt at all in the Maynard patent as illustrated? A. Not on the portion that is touching the cylinder wall, but there is relief of the general area around the boss.

Q. But as a matter of fact the most that you can make out of the Maynard patent is that the web E might be inclined to correspond to the keystone as in Exhibits 1 and 17? A. Well, it is so inclined; it is so shown.

Q. Well, is it your opinion, then, that that would make any difference at all, whether the web is straight or whether it is inclined, so far as the pushing out effect is concerned? A. No, I think very little in that particular case. That is the effect of the so-called keystone shape would be to reduce the area of the bearing surface at the top of the skirt and increase it toward the bottom of the skirt. And of course the reduction of the bearing

area at the top of the skirt is helpful in compensating for the extra expansion at the top.

Q. But the mere inclination is the same, has the same effect as though you dropped a vertical line right from the top where the skirt edge joins the web? A. Insofar as the flexibility is concerned?

Q. Well, yes, as far as the flexibility is concerned?

A. Yes, I think that is correct.

Q. Well, as a matter of fact you don't have a relief, that is a depressed portion of the skirt, a depression in the skirt, in the Maynard patent structure at all; that is a depression in the skirt between the connection of the web and the skirt and the face of the skirt proper; you don't have that illustrated in the Maynard patent, do you? A. Not exactly as shown in Plaintiffs' Exhibit 1, but that whole boss section is generously relieved.

Q. Well, the boss section was very generously relieved in the Ricardo piston, wasn't it? A. Yes.

Q. And you even had overhangs going beyond the skirt, like slightly shown in the Maynard patent, isn't that right? A. Yes.

Q. Where is the action, then, in the Maynard patent structure as far as taking care of the pushing out of the webs against the cylinder wall, different than in the Ricardo structure? A. The Ricardo structure is a rigid structure.

Q. But this closing on this slot don't come into play at all to take care of that pushing out action of the webs, does it? A. Not in Ricardo.

Q. It doesn't come into play at all in the Maynard structure? A. Yes.

Q. In what way does it come? A. There is a slight undercutting, even in the drawings of Maynard, as shown, in the web, and insofar as that horizontal slot is cut back into the web, then the flexibility of the web itself makes the correction. The matter of how far the web is cut into is one of degree, and inasmuch as there are several things contributing to the compensation for the expansion at the top of the skirt in Maynard, that flexibility feature at the top need not be as great as it is, for example in Golick.

Q. Referring to the drawings that you produced, or, rather, the blueprints, Exhibits 21 and 22, and particularly 22, there is a distinct relief shown where appears the lettering "1/8 to 5/32" followed by "H" in a circle? A. Yes.

Q. And that is about the relief that you have on Exhibits 1 and 17, isn't that right? A. Yes, that corresponds pretty closely to that relief. I think the relief is the same, however, from top to bottom of the relieved portion.

Q. Yes, but you have previously said, I believe, that it don't make any difference whether that relief goes down straight the full width, or tapers; isn't that right, it don't make any difference so far as mode of operation is concerned? A. I think I did say that it was preferable to have the taper, that is, you gain the larger bearing area, for one thing, but this piston, which is the Willys-Overland piston, I think has approximately the straight up and down sides of the skirt adjacent the relief after it is finished.

Q. But that relief isn't shown in the drawings of the Maynard patent now, is it? A. No, that particular type of relief is not shown there.

Q. Now, you said that from 1916 to 1919 you had conferences with engineers in the automotive industry including Col. Vincent, that is Jesse D. Vincent? A. Yes.

Q. Did he suggest anything? A. In the way of solving this difficulty he suggested nothing that was of any moment, at any rate. That is, in connection with solving the expansion difficulty. He did, however, have the Packard Company work out a design with an oil groove at the bottom of the skirt for the purpose of avoiding excessive oil consumption.

Q. Didn't he suggest the provision of slots a good deal like in the Franklin piston, Exhibit B? A. No.

Q. And when did you have your conference with Mr. Ferguson of the Pierce-Arrow? A. I had several conferences with him from 1916 to about 1920, as I recall it, or about 1919.

Q. And the Franquist type of piston was never mentioned? A. Not that I recall.

Q. You said that the Jardine piston was used or tried out, I don't know which, in the Templar car in Cleveland? A. Yes.

Q. The aluminum Jardine piston? A. Yes.

Q. Did it ever get into production? A. I think not.

Q. The specific Jardine construction was then dropped after the Maynard construction came out, is that right? A. Yes, to the best of my knowledge.

Q. Have you any Jardine structures, or structure, as shown in the patent, that you can produce? A. I

think so, not here, but I think I can produce such a piston.

Q. Could you produce the Ricardo structure and the Jardine structure tomorrow afternoon? A. Jardine and Ricardo.

Q. Those that were actually tried out, or something so we can see something in metal, see what it looks like?

A. I will try to.

Q. Now, one of the distinctions you made between the Jardine and the Ricardo piston was that the webs were thicker in the Ricardo piston and therefore gave a rigid structure as distinguished from a flexible structure; is that right? A. Yes, I said that Ricardo was designed for rigidity whereas the Jardine construction aimed at flexibility.

Q. Even when the webs 3 of the patent which bridge the main webs corresponding to 25 of the Jardine patent are omitted? A. Yes, that is still true.

Q. Now, those webs did not seriously interfere with rigidity, did they? A. The Ricardo webs?

Q. Those webs C-3 referred to? A. No, they wouldn't interfere with the rigidity. They would make the structure even more rigid.

Q. They wouldn't interfere with flexibility, if it was split, such a Ricardo piston was split as shown for instance at 30-30 on Fig. 8 of the Jardine patent? A. Oh, they would militate against flexibility, yes.

Q. They wouldn't prevent flexibility? A. They wouldn't prevent there being some flexibility.

Q. Wouldn't a structure, if it had those webs, be flexible enough for use? A. I think not, not with the Ricardo sections.

Q. Well, if the webs themselves corresponding to 25-25 of the Jardine piston were made flexible enough, they wouldn't militate against flexibility? A. Yes, if the Ricardo piston is made to the Jardine piston, and the slots put in, of course there would be the flexibility of the Jardine piston.

Q. In Plaintiffs' Exhibit 8 Ray-Day piston there are two good sized ribs on the inside, and those two together give greater stiffness than any single web or rib C-3 of the Ricardo piston, is that right? A. Well, I don't conceive that they would, because the Ray-Day piston has the skirt separated from the head around the whole circumference, and the skirt portion of the Ray-Day is in itself inherently quite flexible.

Q. Isn't the skirt or around the slippers of Ricardo separated from the head all around? A. Not in the sense that they are in the Ray-Day construction. But the Ricardo construction, if made even without the web, would be comparatively stiff, rigid, but even so it would have flexibility.

Q. You believe then that if the structure as shown in Fig. 2, page 274, of The Automobile Engineer, Exhibit 3-S, were split, that is, split between the web, and with the parts of those dimensions, that there wouldn't be sufficient flexibility to do any good? A. I wouldn't say that. I think the drawings shown there in Fig. 2, show somewhat smaller sections than are shown in the Ricardo patent, for one thing, and I suppose nothing short of a trial would demonstrate whether there is enough flexibility there or not.

Q. Well, you have given your opinions freely—I think you are capable of giving your opinions—you would say, wouldn't you, there would be inherent flexibility in those webs enough that if the slipper were split between the webs, those webs would flex sufficiently to have the slot close somewhat? A. I think the construction shown in Fig. 2 of the publication which you have in your hand would show considerable flexibility if the vertical slots were put in the thrust faces.

Q. Those webs are also thin enough to flex, aren't they, as shown in that publication? A. I think so.

Q. In other words, there is inherent flexibility in a structure like the Ricardo structure, as shown in that magazine, isn't there? A. Yes, there was inherent flexibility in the old trunk type piston skirt, so there is inherent flexibility in the Ricardo construction with certain web thicknesses and certain skirt thicknesses.

Q. But Mr. Jardine particularly describes that the webs decrease in thickness toward the wrist pin bosses, isn't that right? A. Yes, he did describe that as his construction.

Q. And that leads to greater flexibility? A. Yes.

Q. Your conclusion, therefore, that the mode of operation was different and that the result was different as between Jardine and Ricardo is based upon the fact that there are no slots in the Ricardo piston? A. Yes, if you take the case of what might be called a modified Ricardo, that is the essential difference in mode of operation.

Q. And if you split almost any Ricardo slipper vertically, no matter what the thickness is, that is the thick-

ness that is ordinarily used in the Ricardo piston at that time, you would have enough inherent flexibility there to be operative in an engine, isn't that right? A. Yes, I think that is not a fair conclusion. That is, there first had to be the idea of making a piston of that construction operate satisfactorily, that idea utilizing the flexibility due to cooperation of the horizontal and vertical slots; and then there had to be the matter of proportioning the various parts so that that flexibility would be proper to properly operate in the motor.

Q. In other words, to you it seems that the first thing that should occur is the idea that there should be flexibility of the ribs? A. No, that seemed to be about the last thing that occurred to the people actually working on it, and certainly it didn't occur to the Ricardo people. They tried to make this thing work as they said it ought to work in an engine, which is a rigid box structure with non-flexible webs and skirt constructed as one unit.

Q. Did you say that the Ricardo piston is a two-walled structure? A. Only in part, the part at the head portion is doublewalled, whereas one of the structures shown in Jardine is a single-walled structure all the way up.

Q. In other words, Figs. 1 and so forth, on sheet 1? A. 1 and 2.

Q. 1 and 2 of Jardine are two-walled structures because the web comes up to the head; is that right? A. That is correct.

Q. And by springing the webs from the ring flange it makes a one-walled structure; is that right? A. Yes.

Q. And it was entirely possible to make the Ricardo piston in a permanent mold nevertheless? A. It was worked out, yes, as a permanent-molded piston.

Q. And the distinction between the Ricardo piston and the Gulick piston is, again, that the Gulick webs are flexible and Ricardo's weren't, made that way for flexibility; is that right? A. That is one of the distinctions; of course there are others.

Q. The webs extend from the head in exactly the same way as in the Ricardo piston—I don't mean exactly, —I mean generally the same way? A. Yes.

Q. And one of the differences is that the outside of the skirt, that is, the part outside of the webs is left off in the Ricardo piston? A. Yes; by relieving a portion of the Gulick construction, namely the side walls at the

skirt in a certain manner, one would have a structure simulating the Ricardo at least, but it would still be much more flexible in a lateral direction than Ricardo.

Q. And flexible because there is a split between the webs? A. Flexible because of the split and because of the design of the webs to produce flexibility.

Q. In other words, there must be deliberate design of the web to produce flexibility? A. I don't know that there must be deliberate design to produce flexibility, if the design is capable of doing that, but there certainly must be a correct proportioning of the different parts as to location and thickness in order to produce the desired results.

Q. You cannot rely upon the inherent flexibility of any given structure, then, to produce that result, can you? A. No, I think not.

Q. Now, as far as the Maynard patent is concerned, if I understand your position, the distinction between Maynard and Ricardo, in addition to the distinction which you have pointed out with reference to Jardine, is that there is a ring at the bottom of the skirt? A. That is one of the differences. Of course I mentioned also Maynard is the single-walled construction.

Q. Yes; I intend to include all the differences of Jardine. A. That is correct.

Q. And it is your opinion, as far as the Mooers patent is concerned, that Ricardo uses the principles of the Mooers patent? A. In part, yes. He has the head connection by means of the connectors going to the bosses, so that the boss section is expanded more than it would be if it were not for the horizontal slot; and he has relief around the bosses so that this expansion can be utilized to assist in taking care of clearance.

Q. You consider relief in the region, for instance, of the wrist pin bosses, where the connections with the skirt are made as shown in the Mooers patent, the equivalent of simply a pair of webs, separated, moved inwardly, and connected to the head, as in the Ricardo piston? A. No, they are not the equivalent for everything; but the functioning of the Mooers structure in so far as thermal distortion and mechanical distortion of the top of the skirt is concerned, will take place to an extent in the Ricardo.

Q. And I believe you said—correct me if you haven't said so—that the length of the slot, 56a, of the Jardine patent, is a matter of degree? A. Yes.

Q. How much of a slot will you need in order to still perform the function? A. Well, I must go back to say 1919 or 1920, according to my own recollection, and say at that time that no one could say how much of a slot would be needed, and I may say to-day that the proportioning of the slots and the sections and the reliefs are the result of a great deal of effort and a great amount of experience, and that different degrees of flexibility are required for different constructions, and different degrees of flexibility are required in different sizes of cylinders, and different degrees are required in the different specific designs of pistons.

Q. Would you say that a slot extending inwardly or a slot like 29a on the Jardine patent Fig. 4 extending inwardly, about as much as shown in Fig. 2, page 374 of Exhibit 3-B, is such a slot as contemplated by the Jardine patent? A. Well, in view of the somewhat thicker sections of metal in these webs, in view of the cross-rib between the webs and on the inside of the piston head, and in view of the shortness of the horizontal slot to which you referred, I should say that that particular structure would lack the flexibility.

Q. You don't think that the web by which you probably mean the parts shown at X, which I will mark "X," can materially affect the flexibility, do you? A. Yes, I think it does, especially at the top of the skirt. It would not materially affect the flexibility at the bottom of the skirt.

Q. You think it affects it more than like, for instance, the webs 27 and 27a of Jardine, Fig. 7, and the webs shown at the top of the piston in Fig. 2 of the Gallick patent? A. Yes, I think the webs in the drawing to which you referred, tie the inside walls of the vertical webs together in the manner desired for a rigid structure.

Q. Isn't it a fact that as far as the Gallick view, for instance, is concerned, the parts above the wrist pin bosses are supposed to be rather stiff? A. That is true to an extent of Figs. 1 and 2, but the construction shown in Figs. 5 and 6 is more flexible.

Q. Fig. 1 of Exhibit 3-B corresponds in general to the drawings of the Ricardo patent 1,294,533, does it not? A. Yes, they correspond fairly closely.

Q. Would you say that the objects and advantages and purposes of the Jardine patent are secured if the

slots 29 were shortened to terminate about the inside part of the ring flange 23? A. It would be quite difficult to secure successful operation under those conditions.

The Master: We will recess now until 1:30 tomorrow afternoon.

(At 1:30 p. m., Tuesday, January 24, 1933, the hearing was resumed. Same appearances as last noted, and Zay Jeffries resuming the stand:)

Q. Doctor, in your discussion of Defendants' Exhibits BBB and CCC, comparing them with the patents in suit, you laid stress upon the strengthening of the walls inside and above the wrist pin bosses. That adds additional strength to that point, doesn't it, in each of those? A. Yes, it does.

Q. Now, if such a piston has horizontal slots in it going through the wall, it is of course necessary to strengthen the piston structure at the attaching point? A. Well, whatever is necessary to make the piston function so that all these things work together in the proper way, is done, that is true.

Q. That is quite usual, isn't it, to strengthen the parts by ribs where you want to strengthen it, where you have two connected parts in order to make a firm, strong connection, to provide a rib or an enlargement at the point of connection? A. If strength is the only factor to be taken into consideration, that can usually be done by strengthening the material itself, or changing the section.

Q. Wouldn't you say that was one of the purposes of adding those inside reinforcements to Exhibits BBB and CCC? A. Yes, that is one of the purposes.

Q. Particularly so where generous reliefs are provided in the region of the wrist pin bosses? A. Particularly so in those particular structures, more particularly in BBB.

Q. Because the slot extends all the way around? A. Yes. Yes, because the horizontal slot is relatively deep above the boss.

Q. But as a matter of fact the strengthening part is greater in CCC than in BBB, isn't it? A. Yes, as the piston is finished.

Q. As you see it, as you actually see it, the extension of the inside reinforcement is greater in CCC than in BBB? A. Yes.

Q. It is your position, then, that a structure like CCC, in which you have two horizontal slots below the ring lands and a relief opposite each wrist pin boss, causes this structure to embody the improvements of the Moore patent, leaving out now the vertical slot? A. Yes.

Q. It is also your position that as long as the vertical slot is provided, it incorporates the features of the Gulick patent? A. Yes.

Q. And also of the Jardine patent? A. Yes.

Q. You would consider the skirt part opposite the wrist pin bosses the equivalent of the webs in the Gulick structure? A. In so far as the flexing function is concerned it is the equivalent. It is not as effective as the structure shown in Gulick, but it is the equivalent of it at least in part.

Q. And you also consider that those relieved parts, that is, the metal left by those relieved parts in CCC are the equivalent of the webs of the Jardine patent? A. In function, yes.

Q. But not in structure at all? A. Not exactly in structure, no.

Q. And you would also consider the equivalent of the parts F in the Maynard patent? A. Yes, in so far as the function of flexing is concerned, and also relief, they are substantially equivalent to the Maynard patent. In so far as boss support is concerned, they would hardly be as good, that is, I would consider it an impairment of the Maynard boss structure.

Q. You would consider the skirt portion on each side of the vertical slot in CCC more flexible than those of Exhibit 1, I mean the entire skirt portions are severed by the horizontal slots? A. I should consider it somewhat more flexible than Exhibit 1.

Q. Both at the top and the bottom? A. No; merely at the top of the skirt.

Q. As a matter of fact in Exhibit 1 the bottom of the skirt which is mounted together with the part going across and on which the wrist pin bosses are mounted, form together an arc and a chord across the arc, don't they? A. Yes.

Q. And that is really a stiff construction? A. That is stiff in vertical direction, yes.

Q. Not in the transverse direction? A. Not so stiff laterally, no.

Q. You think it is as stiff laterally as Exhibit CCC?
A. Oh, I don't know; I should say that both pistons would function substantially the same in a motor.

Q. Why do you say that the Exhibit CCC is more flexible at the top than Exhibit 1? A. It has a somewhat longer horizontal slot and hence longer lever arms for the skirt to flex in the vicinity of the skirt top.

Q. Exhibit BBB distinguishes from CCC merely by the fact that the division is all the way around; that is, the slots don't run out in the air but actually extend below the head of the piston so as to form an actual groove below the head of the piston; isn't that right; that is the distinction between CCC and BBB? A. That is the main distinction in so far as the structure is concerned, although Defendants' Exhibit CCC has a projection on the inside of the skirt corresponding somewhat in area to the relief on the outside of the piston around the bosses, which BBB does not have.

Q. Do you consider that the essential structure, function, and mode of operation of the two pistons, Exhibits BBB and CCC are the same? A. Broadly speaking, yes.

Q. Well, do they distinguish at all? A. They distinguish in the depth of the horizontal groove at the top of the skirt; the depth in BBB being considerably greater than that of CCC immediately above the bosses.

Q. When you say "depth" do you mean that in CCC the depth of the groove is zero, that is, above the bosses? A. There is no actual groove for a distance of approximately an inch above each boss; but the relief is carried to the ring section at that point, so that the bearing surface is not continuous around the skirt at the top in either of the pistons.

Q. In your opinion, then, it doesn't make any difference in the mode of operation whether there is a groove right directly above the wrist pin bosses below the top of the ring lands?

Mr. Richey: Referring to Exhibits BBB and CCC.

A. The mode of operation is substantially the same.

The Master: You have used an expression there I didn't understand, both the counsel and the doctor. You spoke about this slot extending out into the air. What do you mean by that?

Mr. Bruninga: What I mean in Exhibit 17 and also in Exhibit 1 is that there is a slot running

around the piston. Part of that slot is actually existing; the rest of it goes out into the air for 180 degrees.

The Master: It is not continuous?

Mr. Bruninga: It is not continuous at all.

The Master: That is what I wanted to be sure that I understood.

Q. I believe you said that the skirts of Exhibits BBB and CCC were thicker than necessary, particularly Exhibit BBB? A. Yes, I think so.

Q. Does that affect the flexibility of the skirt? A. Yes, it affects the flexibility.

Q. But in your opinion there is considerable latitude permitted say in thickness and still secure flexibility?

A. It is not a question of the latitude and thickness solely; it is a question of the combination of the thickness, the extent of the horizontal groove, the vertical slot, and its position, the material of which the piston is made,—all of those things must co-operate together to get the proper fit in the motor at all temperatures. So if one thing is changed, it may require a change in other features in order to get the right combination.

Q. Why did you say that Exhibits BBB and CCC were more nearly like Mooers; I believe you said that? A. Yes, the Mooers principle is utilized in Exhibits BBB and CCC to a very great extent, and very effectively, especially on the maximum thrust face, or maximum thrust side of these pistons. The principle described by Mooers is clearly used in these pistons. The head expands more than the skirt, the flow of heat is restricted to locations in the regions of the bosses, thus making those portions of the guide sections expand more than would otherwise obtain, and that in turn produces a distortion of the bearing section proper in the direction of moving the bearing face in toward the wrist pin. And in so far as that principle is effective, it permits of closer fitting of the piston when the motor is cold, with the compensation becoming greater as the piston is heated, in fact, just the time when compression is most needed.

Q. And that is because the connectors are rather narrow? A. That is because the connectors are narrow and because they act both thermally and mechanically to produce that result. That is also made possible only by the generous relief of the skirt section in the region of these connectors, as is clearly present in both Exhibits BBB and CCC.

Q. You would call the relief in CCC generous, then, would you? A. Yes, the relief there is so much that it can be felt easily with the finger, and it can even be seen with the unaided eye.

Q. Now, the reason you said it is more like Mooers is because in Exhibits 1 and 17 you have rather wide connectors, don't you? A. Yes; the connectors are wider in Exhibits 1 and 17.

Q. Would you say rather wider or would you say they are about twice as wide? A. Oh, they are considerably wider.

Q. About twice, isn't it? A. I should think so.

Q. And still you consider Exhibits 1 and 17 as embodying that particular improvement of the Mooers patent? A. Yes.

Q. In other words, in order to embody it, the connectors could be anywhere between Exhibit 1, for instance, on one hand, and Exhibit BBB on the other; is that right? A. I should think so, if the principle became effective.

Q. That is the principle of having reliefs, substantial reliefs opposite the wrist pin bosses and connectors from the head to the skirt? A. Well, it is a three-way combination: it demands a horizontal separation. It demands restricted connectors which act mechanically to pull the skirt out more in one place than another; and acts as a thermal connection to heat the skirt to a higher temperature than would otherwise obtain, which accentuates the distortion of the head. Now, all three of those factors are present in Plaintiffs' Exhibits 1 and 17, and they are all present in Defendants' Exhibits BBB and CCC.

Q. Doesn't Exhibit CCC look mighty like a trunk piston to you with horizontal and vertical slots in it? A. It is a trunk piston with life in it, yes, and a trunk piston that is so modified with reference to its boss connections and with reference to the proportioning of its sections and with reference to the presence of slots, both horizontal and vertical, as to produce an entirely different result and a different mode of operation.

Q. If you take the structure, Exhibit 3-H and put a T-slot in one face of this piston, with the horizontal of the T below the ring land and with the vertical of the T extending from the horizontal down to the end of the skirt, you would secure the structure in Exhibit CCC, wouldn't you? A. No.

Q. Why not? A. Because you would still have a dead piston, especially at the top of the skirt. Will you place the grooves and then I will tell you?

Mr. Richey: I object to this as immaterial; no such construction before the court.

The Master: He may answer.

A. (Continued) (After counsel indicates groove on Exhibit) No; that piston would still function like a trunk type piston, only perhaps worse.

Q. Because it has not the slots on the other side?

A. No; because the slot is improperly placed; the horizontal slot is not placed there to do any good.

Q. What I have shown there is a horizontal slot below the top of the ring land and extending into the relief, and a vertical slot midway between the wrist pin bosses and extending to the ends of the skirt; and you say that would not produce a structure like Exhibit CCC?

A. No, it would not.

Q. Why not? A. Because the maximum clearance is required at the very top of the skirt, and you have placed the slot at some distance from the top of the skirt and hence the portion which is slotted, namely, the band at the very top of the skirt, will require even more clearance than the ordinary trunk piston, because it will become hotter opposite the horizontal slot than the ordinary trunk piston, and the piston would seize or otherwise rub unnecessarily hard against the cylinder wall.

Q. But suppose I place the horizontal slot $1/8''$ below the ring groove, the lowest ring groove? A. Well, you are suggesting something there, I suppose the next question would be $1/16''$, and the next $1/32''$.

Q. Just answer the question.

Mr. Richey: I object to all this. We will never get through here if he is going to ask something that is not before the court.

The Master: He may answer.

A. If you move the slot into the proper position as taught by Jardine and by Maynard and as is present in various of these exhibits in suit, and otherwise proportion the structure as to section thickness and location of various slots, you may get the same result as is found in the structures in the patents in suit.

Mr. Bruninga: Answer objected to as not responsive. I move to strike out and that the witness

be required to answer the last question. Read the question again.

The Master: Motion overruled, and the answer may stand to preserve the record; but the witness will have the question again and be instructed to answer.

(Previous question read.)

Mr. Richey: You are talking about what exhibit?

Mr. Bruninga: Exhibit 3-H. I will ask the question again so there will be no misunderstanding.

Mr. Richey: He is not preserving this construction he is talking about. How are we going to have a check on it?

The Master: Well, he is defining his structure in his question.

Mr. Bruninga: I will reframe the question so that there will be no mistake about it.

Q. Suppose I cut a slot through the wall of the piston Exhibit 3-H, circumferentially and 1/8" below the lowest ring groove, running into the reliefs, and a vertical slot connecting with that circumferential slot and running to the end of the piston and placed midway between the wrist pin bosses. In what way does such a structure distinguish from Exhibit CCC? A. It still distinguishes by the fact that the horizontal slot is not properly located to gain the advantages of flexibility.

Q. That is your answer? A. Yes.

Q. And in order to answer it, you would want to give your previous answer explaining that it must incorporate Jardine, Maynard and Mooers and all these others? A. Yes, I would want that to stand.

Q. And that is the only answer you can give; you cannot be definite about it at all, how it should be placed?

A. How the slot should be placed?

Q. Yes. A. Yes, I can be very definite.

Q. By metes and bounds, or quarter inches or one-eighth inches, one-sixteenth or one-thirty-second? A. No, not by hair splitting. I can give you the limitations of function and result.

Q. In spite of the fact there is not a dimension given on any of the drawings of Gulick, Mooers, Maynard and Jardine? A. Yes, in spite of that.

Q. You really don't want to answer the question, do you? A. I have answered the question, I think.

Mr. Richey: I submit he has answered the ques-

Q. But you can't tell the Court, then, in what respect the structure that I gave you fails to function on account of location of the upper slot, whether it should be one-eighth inch or one-sixteenth inch, or what the length should be with reference to how far it should go into the reliefs? A. No, I cannot define those boundaries, and furthermore I know of nobody that can define those boundaries in a structure of this sort (indicating Exhibit 3-H). People may think they know a lot about calculating stresses and so forth, but it has been my experience in connection with this piston business that there has been very little forecasting of what a particular piston construction would do in a motor. The answer, even by the best mathematicians, has been gained by tests. So when a patent describes that a piston should operate in a certain way, and when it discloses a structure which will operate in that way, I think that that in itself is significant, that is, there is a structure which does what the patentee requires of it. Now, this iron piston that you referred to, Defendants' Exhibit 3-H, if slotted horizontally as you indicated, say three-eighths of an inch or more than a quarter of an inch below the top of the skirt, I am certain about that, that is that the upper band of the skirt will still expand to the same extent or to a greater extent than it would in a trunk piston, and that that is the very region where the expansion is the greatest and where compensation for the excess expansion must be provided to the greatest extent, or at least to a sufficient extent; so that as you move the slot gradually upward, you finally put it where Jardine puts it and where Maynard puts it, in a place clearly above the upper part of the skirt, and then it functions.

Q. You think that can be determined from all the patents in suit? A. This business is still quite an art and it was very much more so before these patents in suit, so that when you ask me a question of that sort I am unable to give you any broad answer. The patents in suit do teach these principles of operation, the general lines of construction, and the result.

Q. That is all you want to tell us of how you locate that slot? A. Yes.

(Short recess taken.)

Q. Doctor, I believe you said that in Exhibit BBB and CCC the top of the skirt was more flexible than in pistons 1 and 17, but that the bottom had about the same flexibility? A. Well, as near as I can tell from feeling it.

Q. I don't mean by feeling. You get that from the general structure? A. No, I get flexibility from feeling.

Q. Now, it is the top where the greatest flexibility is required, isn't it? A. Not necessarily. It is the top where the greatest compensation for clearance is required, but if that clearance is compensated for by means other than flexibility, then the flexibility would not be required to a greater extent at the top than it is at the bottom.

Q. Well, you really get flexibility at the bottom, good flexibility, by a construction such as Defendants' Exhibit BBB, don't you? A. Yes, it is no trouble to get flexibility at the bottom of the skirt, if that is all that is required.

Q. In fact, you can get that by a single slot between the wrist pin bosses, going part way up the skirt, say above the region of the wrist pin bosses? A. Yes.

Q. I believe you said on re-direct examination that the piston, Exhibit 20, the Gulick piston, was very flexible? A. Yes.

Q. And I believe you also said the larger the piston the more flexible it will be? A. Yes, that is correct. It is easier to get flexibility in a large piston than it is in a small piston.

Q. And that flexibility is particularly required in the large piston, but not particularly required in the small piston? A. It is required in all sizes of pistons for pleasure cars at the present time where aluminum alloy is used for the piston.

Q. But that is the fact, isn't it, that the flexibility for a small piston, such as Exhibit 20, is not as great as for a piston of the size of Exhibits 1 or 17? A. Well, the extent of clearance compensation in thousandths of an inch is not as great in a small diameter piston as it is in a large.

Q. In fact the clearance required for even aluminum pistons is usually measured in thousandths per inch diameter, isn't it? A. Yes, or thousandths per diameter of the piston.

Q. But automotive engineers have in the past at least taken the position that the clearance should in-

crease as the diameter increases, if there is no compensation for clearance? A. That is correct.

Q. Have you ever tried out a piston like Exhibit 20, or as large as Exhibits 1 and 17? A. No, I have not.

Q. I show you a piston which I will mark for identification Defendants' Exhibit 3-T, which I believe is a fair exemplification of the structure of the Gulick patent. You can look at it, and, again, I don't want to tie you down to dimensions till you have measured it, but I will say that that corresponds to the half section, Exhibit 3-B; I am sure they were made in the same mold, with the same pattern. That corresponds generally to the Gulick patent structure, doesn't it? A. Yes, it corresponds generally.

Q. Now, Exhibit 3-T, the Gulick piston, as well as Exhibit 3-Q, the Franquist piston, and Exhibit 3-P, the Spillman & Mooers piston, each have a wrist pin in it that naturally makes the structure stiff, doesn't it, if the wrist pin is in pretty tight in the bearings? A. Well, one can freeze the wrist pin in the bosses and make the structure tighter, that is correct.

Q. Well, you can examine these and see that the wrist pin is not loose in those bosses; that is a fact, isn't it, in all three of these pistons? A. Yes, the wrist pins seem to be in unusually tight, in fact, frozen in there.

Q. That naturally makes the piston structure stiffer than if the wrist pins were left out entirely? A. Yes, it does. That is not a fair fitting of wrist pins, in these structures, however.

Q. You think it is too tight? A. I am sure it is too tight.

Q. Just how loose should a wrist pin be in a piston? A. Well, in an aluminum boss or where at least the boss is supposed to serve as a bearing, it must be loose enough so that it will not freeze even at sub-zero temperatures, because the motor is supposed to stand out and be able to function at sub-zero temperatures. So that if the wrist pin is expected to bear in the boss in the Gulick piston, for example, it is too tight as it is at the present time.

Q. Well, you would say it is then also too tight in the other pistons? A. Well, in the Franquist piston, perhaps this is intended to function tightly, maybe in the Gulick. I don't know whether you have this set for

a fixed wrist pin or whether you have it set for a wrist pin which is supposed to bear in the aluminum bosses.

Q. But fixed wrist pins are usually set pretty tight?

A. Oh, fixed wrist pins can be set quite tightly, yea.

Q. Is it your opinion that in that Gulick structure the wrist pin was intended to be set tight? A. In the principal drawings, yes, Figs. 1 and 2, there appear to be the two places for the locking of the wrist pin. In the lower drawings Figs. 5 and 6, there appear to be no means shown, at least, for locking the wrist pins.

Q. But in the Mooers patent it is intended to be clamped in by screws? A. On one side only.

Q. But as you read the drawings, in Figs. 1 and 4 of the Gulick the wrist pins are intended to clamp in, aren't they? A. Apparently, yes.

Q. Well, it is your opinion, isn't it, that the pistons will function with wrist pins clamped in that way? A. Yes, I think they will.

Q. Function as you have described? A. Substantially. If the locking is too tight, that reduces the flexibility, especially around the bosses.

Q. Well, wherever set screws are used, there is no loose fit, is there, there is a pretty tight fit? A. Well, there should not be any looseness, especially in the cold.

Q. You haven't shown a wrist pin in Exhibit 20, and you would therefore expect the structure to be more flexible than if there was a wrist pin in there; isn't that right? A. Yes, it would be more flexible than if the wrist pin were fitted in.

Q. And in that model as you have shown it, those wrist pin bosses are intended to receive set screws? A. I think not. In this case I think the holes there are probably oil holes.

Q. Examine it again, please, and tell me if you would put a boss around an oil hole? A. I think the boss was put on there, perhaps merely because it is shown in the Gulick drawing figures 1 and 2, but I find no threading about those holes, so consequently I conclude they are oil holes.

Q. But, answer my question: naturally you would not put a boss around just because you had an oil hole? A. It wouldn't be necessary.

Q. In fact that boss indicates it is intended to receive a set screw? A. Yes, I said that before.

Q. Now, these structures, Exhibit 3-P, 3-Q, and 3-T, are they more stiff if they do have the wrist pins in

Mr. Bruninga: And you don't admit that a structure exactly like Exhibit 1 was in the Simmons case?

Mr. Richey: I say if you want to prove these things you must get proper proof, so as to get both sides in.

Mr. Bruninga: You have admitted it before.

Mr. Richey: I haven't admitted it.

Mr. Bruninga: You don't admit it now but you did admit it before.

Mr. Richey: If I did admit it I admitted it unconsciously. I neither admit or deny those things, so you will have to put in the proof.

Mr. Bruninga: You mean that was under a misapprehension, when I asked you if you would produce the record in the case and you said you didn't want to produce it but would admit it?

Mr. Richey: I don't remember saying it.

(Previous question read.)

A. I can't answer as regards the question, with the exception as to whether I have tested a Spillman & Mooers piston with a vertical slot in it. I have not tested such a piston except with my hands and with a so-called can-opener testing device, Defendants' Exhibit 3-I, in this case or in this suit. I do not recall that I have ever seen a Spillman & Mooers piston with a vertical slot in the skirt placed between the bosses and connecting the bottom of the skirt and the horizontal slot, prior to this suit and prior to seeing Defendants' Exhibit 3-P.

Q. The specification of the Spillman & Mooers patent 1,092,870 reads as follows, page 1, lines 71, *et seq.*: "In the construction illustrated in the drawings, the web is separated from the surrounding walls of the head and guide sections, by a comparatively wide space, and the upper end of this connecting web joins the back of the head sections, while its lower end joins the guide-sections near its lower end or at a point remote from the non-conducting gap 6, whereby the amount of heat transmitted through the web from the head to the guide-section is reduced to a negligible degree, not only on account of the remoteness of the lower end of the web from the gap, but because the web is constantly cooled by the large volume of oil in the crank case." Do you understand by that description that the structure should be exactly as indicated in the drawing, and that is the exact distance from the lower end as indicated in Fig. 2? A.

I don't know what latitude would be permissible in that connection.

Q. You have not had any trouble in telling us the latitude in connection with the patents in suit, have you?

A. Yes, I have very considerable trouble.

Q. You think, then, that the statement that it joins the guide section near the lower end or at a point remote from the non-conducting air gap 6, would necessarily mean it is at the extreme lower end of the skirt, that connection, or might be higher up and still be remote from the top of the skirt? A. I don't know.

Q. You cannot answer that question? A. No.

Q. You said that the Spillman & Mooers piston cannot be fitted as close as the Gulick piston. You had in mind of course an unsplit structure, isn't that right? A. Yes.

Q. And can you give me or the Court your opinion as to whether that would be possible if it were split as in Exhibit 3-P? A. Oh, I think if you make a live piston out of the Spillman & Mooers by having the slots described by Gulick cooperate in the same way to produce the same mode of operation, that it would be possible to fit the Spillman & Mooers piston with smaller clearances than that of the disclosure of the Spillman & Mooers patent.

Q. But if there was no slot, vertical slot, midway between the wrist pin bosses connecting the bottom of the skirt with the horizontal slot, what would you then say as to close fit? A. That is what I supposed in my previous answer.

Q. You supposed that to be the change? A. Yes.

Q. And that is your answer? A. That applies particularly to the top of the skirt section rather than to the bottom of the skirt, however.

Q. The bottom of the Gulick skirt would be more flexible than the bottom of the skirt in the split Spillman & Mooers? A. Yes, very much more flexible.

Q. Now, with reference to the Mooers patent, one of your distinctions over the Spillman & Mooers patent was that the Mooers patent structure was a single-walled body, as distinguished from a double-walled body. That is also the distinction between Jardine and Gulick as to that—that is one of the distinctions between Jardine and Gulick; isn't that right? A. That is one distinction, yes, and especially one of the structures shown in Jardine.

Q. Now you also said another distinction between the Spillman & Mooers and the Mooers patent was that in

the Spillman & Mooers patent structure the relief was between the connections on which the wrist pin bosses are mounted and the skirt. That is also a distinction between Gulick and Jardine? A. I think I said that the relief in the Spillman & Mooers was hardly a relief. The hole is present there for the purpose of putting the wrist pin in place. It is not described, as I recall it, as a relief. But, even so, it would have in my opinion no function as a relief, the way it is constructed.

Q. You can say the same thing about Gulick, can't you? A. Yes.

Q. Now, in the Spillman & Mooers patent structure there are oil holes, 9, at the bottom of Figure 3? A. Yes.

Q. What is the purpose of those oil holes? A. To let the excess oil that might otherwise collect in the pocket between the web and the skirt escape.

Q. Where? A. Onto the cylinder wall.

Q. To be wiped by the lower part of the skirt against the cylinder wall? A. Yes, it would so function.

Q. You stated that you did not know at the time that you experimented with the Ricardo piston about the Gulick piston; I believe that is correct? A. That is correct.

Q. When did you find anything about the Gulick piston—when they took your deposition? A. A short time before that, yes.

Q. In 1926. Well, that was a considerable time after the Jardine piston was developed, isn't that right? A. Yes, it was some time after that, I don't recall the date, however.

Q. Now, one of your distinctions that you gave between the Franquist patent and the Gulick patent was that Franquist was a single-walled structure while Gulick was a double-walled construction. That is also the distinction between one of the accused devices, Exhibit 1, and the Gulick patent; isn't that right? A. That is one of the distinctions, yes.

Q. In other words, as far as that is concerned, the accused device, Exhibit 1, BBB and CCC are more in the direction of Franquist, I mean as to that one feature of being a single-walled construction? A. Insofar as that one feature of the construction is concerned, that is true.

Q. You said that the Franquist patent structure was similar to a trunk piston, and I take it that you mean that even though the Franquist patent discloses relief in the regions of the wrist pin bosses and in the connectors, not in the connectors but in the parts of the skirt around the

wrist pin bosses from a little below the wrist pin bosses to the top of the skirt? A. I did not have that feature in mind and I meant the head and the full skirt portion particular.

Q. And it is your opinion, even if the Franquist patent is made out of cast iron, it will have no flexibility at all? A. It will have insufficient flexibility to cause the piston to function substantially different from that of the trunk type piston, in my opinion.

Q. Is that due to the fact that the relief opposite the wrist pin bosses is insufficient? A. No, that is only one of the factors. The other factor is the rigidity of the vertical groove sections, and still another is the horizontal separation being put in a ring groove so that the ring has an opportunity to transmit heat across the gap formed by the horizontal slot.

Q. You think, then, that is the wrong place to put the horizontal groove in the ring groove? A. Not necessarily, it is according to what is desired of the horizontal groove.

Q. You wouldn't think that would be an impairment of function to put it in the ring groove rather than some place below? A. It would if the function desired is the Mooers' function, that is, one of heat insulation; but it might not if the function is one of gaining flexibility, such as Gulick, Jardine and Maynard constructions.

Q. The Franquist patent states as to these grooves or slots, "Circumferential slots 17-17 are cut in the outer surface of the sleeve in the sections 15-15 respectively, while slots extend to and join the longitudinal slots of 13, separating the longitudinal sections 15 from the head of the piston." That doesn't specifically state the horizontal slot has to be at the bottom of the ring groove, and in fact we do not find anything in the patent that states they should be placed there except the illustration in the drawing? A. (After examining patent.) No, I see no other reference to its construction in the specification.

Q. As a matter of fact in the Ford Eight piston, Defendants' Exhibit 3-J, the horizontal slot is placed in the lowest ring groove, isn't it? A. Yes, it is, and in that piston the Mooers principle does not apply anyway on the slotted side.

Q. Does it apply on the unslotted side? A. No, not on that piston because there is no horizontal slot on the side which is not vertically slotted.

Q. And in the Chrysler piston, Exhibit 3-O, you find the same thing, and therefore your answer would be the same?

Mr. Richey: I object to this as immaterial.

The Master: Same ruling.

A. The same as has been said of the Ford piston applies to the Plymouth piston with reference to Moers.

Q. Now, in your opinion the grooves in the Franquist patent structure are not sufficiently flexible to be operative in order to compensate for expansion, is that your position? A. Yes.

Q. And in spite of the fact that the patent specification specifically states that the structure is flexible? A. Yes, he was just wrong.

Q. Absolutely wrong? A. For practical purposes, yes.

Q. In other words, that is just an ordinary trunk piston, in force and effect? A. Why, probably worse than a trunk piston.

Q. But you do know that The Cleveland Trust Company has been drawing royalties under that patent?

Mr. Richey: Object to it as immaterial. The records are the best proof. This witness don't know.

A. No, I don't know that.

Q. You don't think, then, the vertical grooves of the Franquist patent structure are the equivalent of the vertical slots of either the Gulick, Maynard or Jardine?

A. No.

Q. I believe you said that the relief as described in the Franquist patent was not sufficient for use with aluminum alloy, is that right? A. That is correct.

Q. Because it is stated to be so many thousandths inches deep? A. Yes.

Q. But you would have to use a larger or smaller relief when you use aluminum as compared with cast iron? A. Well, so far as my knowledge goes, the relief structures for that purpose haven't been used on cast iron, or at least haven't been necessary.

Q. Is that your understanding of what the practice in the art has been, that the reliefs have not been used on cast iron pistons? A. Not been for the purpose used in the patents in suit, that is my understanding. There has been relief in the cast iron pistons around the boss sections. My understanding is it is to take care of the mechanical weaving action of the skirt adja-

cent the bosses as a result of the stresses due to the explosion stroke and the inertia forces.

Q. That has also been your understanding where aluminum trunk pistons were used? A. In some cases, yes.

Q. But the practice has been to make those reliefs deeper when aluminum trunk pistons were used than when the cast iron trunk pistons were used? A. No, I think not, not in the case of the trunk pistons, that is not in the instances where both of the pistons are in the trunk type.

Q. It is your idea then that Mr. Franquist should be tied right down to the exact dimensions he has stated as to the depth of the relief?

Mr. Riehey: I object to that as immaterial; that is something for the Court to define, the interpretation of the patent.

The Master: I think that should be sustained.

Mr. Bruninga: This witness has stated the relief as stated in the patent is not sufficient to accomplish the purpose. I asked him whether he should be tied down to that.

The Master: I will make the same ruling, let him answer and you may have your exception.

A. I don't know what latitude is permissible.

Q. And it is your opinion then that as far as Exhibits 1 and 17 are concerned, the flexibility at the top of the skirt is greater than the flexibility at the top of the skirt in the Franquist patent structure? A. Yes, very much so.

Q. Is it, again, founded upon opinion rather than upon actual tests in an engine? A. No. I would say we have a tremendous amount of commercial art to the effect that pistons like Plaintiffs' Exhibits 1 and 17 and Defendants' Exhibits BBB and CCC function properly in motors, and inasmuch as there is a tremendous amount of commercial art in those directions, that I assume to be established as a fact, that such pistons are commercial and satisfactory in service.

Q. It is then founded upon what you know of other pistons and not upon any actual tests with the Franquist piston, is that right? A. I have run no actual tests on the Franquist piston, that is true, so far as motor operation tests are concerned. I have conducted some stiffness tests on the Franquist piston and I am convinced that the circumferential flexibility which the patent

specification of Franquist claims, is substantially absent in the Franquist structure as described, and also in the Franquist structure Defendants' Exhibit 3-Q.

Q. When did you make those tests you talked about yesterday with the Franquist piston? A. 1931.

Q. Here in Cleveland? A. Yes.

Q. What was the occasion for making those tests? A. Made the tests at, as I recall it, about the time the Simmons suit was under consideration.

Q. And you found the Franquist piston worthless at that time? A. I didn't say I found it worthless. I think it would probably be as serviceable, generally speaking, as a trunk type piston, maybe not quite as good, but it is true we found the features claimed in the patent specification to be substantially absent, especially as regards the main feature, that is, circumferential flexibility.

Q. Was that before or after the settlement of the Simmons suit? A. That was before.

Q. Who told you to make those tests? A. I made them under my own—I made the tests because I wanted to make the tests. I wanted to satisfy myself as to the Franquist structure.

Q. Did you report those tests to Mr. Richey or to Mr. McCoy? A. I believe not until quite a bit later.

Q. Before or after the settlement of the suit? A. After the settlement of the suit.

Q. And how did you make those tests, with your hands or with a clamping device? A. I made those tests with a clamping device and a testing machine, and a micrometer.

Q. What kind of a testing device, was it along the order of Exhibit 3-I? A. No, it was the regular tension and compression testing machine. The piston was set in a testing machine with bearings at two sides near the bottom of the skirt, and the deflection and load were measured. First, I found the amount of load required to deform the piston in that direction by ten thousandths of an inch. The measurement was made in two directions at right angles to each other. It was found that the load required to stress this piston, or the stress or load required to deform the Franquist type piston .010" was from 100 to 120 pounds. Next I removed the piston and applied a C-clamp across opposite faces at the bottom of the skirt and deflected the piston .010" the same as it had been deflected in the testing machine. Then I

measured the diameter at right angles to the points of contact of the C-clamp and found that the skirt had expanded in a direction at right angles to the points of pressure to approximately the same extent as another type of piston with a non-flexible skirt bottom. Therefore I concluded that the functioning of this Franquist type skirt is substantially that of the trunk skirt.

Q. Can you tell me a little more accurately when you made those tests? A. Yes, I can. It was September 24, 1931.

(Short recess taken.)

Q. Dr. Jeffries, what was the occasion of making that test on September 24, 1931? A. I was testing the various structures which were under consideration in the Simmons suit.

Q. And that date was the day before the so-called proceedings in chambers before Judge Jones were proceeded with, that you really expected to go to trial on that Simmons case? A. It was just a short time previous. I don't know whether it was the day before or not.

Q. But you were really getting ready for the trial in the Simmons case, is that right? A. Yes.

Q. You knew the Franquist patent was involved in that suit? A. Yes.

Q. You were getting ready to testify as an expert with reference to that Franquist patent? A. Possibly, that is, there was a possibility I would testify.

Q. And you were in rather close conference with Mr. Richey and Mr. McCoy just previous to the trial, weren't you?

Mr. Richey: I object to that as immaterial and having nothing to do with the issues of the case.

The Master: Same ruling; you may have your exception.

A. Yes, I had one or more conferences with them previous to the trial.

Q. Did you tell them previous to the trial that this Franquist piston was no better than an ordinary trunk piston? A. No, I was in fact quite surprised myself. The piston is quite deceptive in looks. Somehow or other that construction looks as if it should be flexible, and I had assumed it was flexible, and I was first struck by the apparent rigidity of it with the hand test and I

wanted to get some kind of a quantitative measurement on it, and I was quite surprised to find how rigid it was.

Q. Can you tell me more accurately the date when you reported that matter to any attorney for the Aluminum Company of America or the Cleveland Trust Company or any of the licensees? A. Well, I should judge it must have been at any rate three or four weeks after I made the test.

Q. But it was within three or four weeks after you made the test? A. I think so.

Q. Who did you report that matter to? A. Well, as I recall it, to Mr. Richey and Mr. McCoy.

Q. Now, in making that test did you make up a piston exactly in accordance with the dimensions as shown in the Franquist patent? A. I didn't measure the dimensions. I used a piston which was supplied by Mr. McCoy.

Q. You didn't even measure the dimensions, then, whether they corresponded with the drawings of the Franquist patent? A. The piston looked as much like the drawing of the patent as Defendants' Exhibit 3-Q.

Q. But you didn't compare the dimensions, did you? A. No.

Q. And you didn't try to make it work by proportioning the parts, more particularly the accordion pleats, as you call them, in order to secure flexibility? A. No, I made no changes in the piston as I received it.

Q. In Exhibit 1 there is only one slot, isn't there, vertical slot? A. Yes.

Q. In Exhibit 3-Q, the Franquist piston, there are four slots? A. There are four grooves in the ribs.

Q. Four grooves in the ribs, let's call them? A. Yes.

Q. And in order to get the same expansion, the closing of the slots can be divided among four—call them grooves instead of slots, if you don't like that word? A. Yes, that is correct.

Q. In other words as far as visual effect is concerned you might get the same, you would get the same compensation for expansion only if each slot closed one-fourth as much as a single slot, if there was only a single slot in the piston? A. That is true, but that does not mean that the flexibility would be four times as much for the Franquist type piston as a result of cylinder wall pressure. The forces tending to close the slots have to be taken into consideration, and of course those forces

act on larger or longer lever arms in Plaintiffs' Exhibit 1 than they do in Franquist.

Q. I believe you stated that for practical purposes the horizontal slot or groove extends completely around the Maynard piston below the head? A. Yes, in the construction shown in the Maynard drawing.

Q. And you can say the same with reference to the Jardine patent? A. Yes.

Q. And you really can say the same with reference to the Ricardo piston, can't you? A. Yes.

Q. The relief is really not needed in the Jardine patent structure because you already have a pair of webs to give you ample relief in the region of the wrist pin bosses? A. Yes, the structure provides its own relief.

Q. And that relief is also in the Ricardo piston? A. Yes.

Q. You talked about mechanical expansion and distortion, I believe, as distinguished from thermal expansion. I didn't understand what you meant by that. Can you briefly give me your position with respect to the Maynard patent structure or the Jardine patent structure to illustrate that? A. Mechanical distortion can be produced by mechanical force alone. The type of distortion which I described with reference to the Franquist piston test was mechanical distortion. I reduced one diameter of the skirt by .010" and increased other diameters at the same time. That was all done at one temperature, namely, room temperature, and that is mechanical distortion. Mechanical distortion may also take place when the piston is heated, even when one part is hot and another part cold. When the bearing faces expand against the cylinder walls, if the bearing is restricted in a lateral plane on the piston that cylinder wall pressure is available to mechanically distort the piston. If there is relief, as implied in the fact that the bearing is not complete, then mechanical distortion can be utilized to compensate for extra expansion of the piston. The thermal distortion is that obtaining in the Mooers construction, for example. In such a piston the head can be heated even when the piston is not mounted in the cylinder. The heating of the head will cause the head to expand, it will cause the heat to flow to the skirt, vertically through the connectors shown in the Mooers construction; it will expand the skirt as the result of temperature alone, but it will expand the skirt an additional amount because of the greater expansion of the head as

compared with the skirt. Such expansion of the top of the skirt is due entirely to differences in temperature, as opposed to the application of mechanical force or load. When the portions at the top of the skirt which are the hottest and which bear the mechanical connection to the head, expand to a greater extent than other portions of the skirt, the piston distorts. In this case the skirt portions removed from the vertical connectors draw in, and in that manner may be utilized to help compensate for the extra expansion at the top of the skirt.

Q. You said that at the time you made this test you were preparing the Simmons case. You knew what particular device was involved in this Simmons case, didn't you, the particular piston? A. Yes.

Q. It was exactly like Exhibit 1, wasn't it? A. It was quite similar, at any rate, to Plaintiffs' Exhibit 1.

Q. Well, you don't know of any distinction, except possibly in size, do you? A. One of the infringing devices was, I think, just the same as Plaintiffs' Exhibit 1, and as I recall it also another piston was the Plymouth four-cylinder piston. I don't recall whether the Ray-Day was in the Simmons suit or not.

Q. You mean by the Plymouth this like Exhibit 3-O? A. No, that is the Plymouth Six. I had reference to the Plymouth Four. It was quite similar to the Ford Four.

Q. Well, did that exhibit in the Simmons case that you said corresponded to Exhibit 1, did that have the general structure of the Maynard patent? A. Yes.

Q. It had these cross webs or cross pieces on which the wrist pin bosses are mounted, like in Exhibit 1; is that right? A. Yes.

Q. You don't remember any distinction over that? A. No, I don't remember any.

Mr. Richey: I think I can clear up some of the facts about the situation. The decree entered in the Simmons suit was a consent decree. The accounting has not been concluded, nothing has been collected on the Franquist patent and we don't propose to collect anything on the Franquist patent. Since we learned of the tests the Doctor made, we have not included the Franquist patent in any of these piston suits. That is correct, isn't it?

Mr. McCoy: That is correct. We withdrew the Franquist patent in the suit against the Lawrence-Ohio Company immediately upon learning of the results of Dr. Jeffries' tests on that Franquist piston.

And counsel were so informed that we had withdrawn that, that is, counsel for Lawrence-Ohio Company.

Mr. Bruninga: What date was that, was it before or after the expiration of the Franquist patent?

Mr. McCoy: It was before the expiration of the Franquist patent.

Mr. Richey: We don't mean by these statements that the Franquist patent didn't possess some validity as to some of its particular features, even though it doesn't possess flexibility.

Mr. Bruninga: That is all.

RE-DIRECT EXAMINATION by Mr. Richey.

Q. These tests you made of the Franquist piston in 1931 that you described, were those exhaustive for the particular purpose you made of them, in your opinion?

A. Were those exhaustive, you say?

Q. Yes. A. No.

Q. Were they sufficient to demonstrate the question of flexibility that you were working on? A. To my mind, yes.

Q. Are they comparable with the tests that you made on pistons to determine their flexibility? A. They are exactly comparable with other tests which I made at the time on other pistons. The test itself, so far as I know, is not a criterion in the testing of a piston in use. The criterion is the motor test, that is, the test in operation within a cylinder under power.

Q. Would you expect those pistons to operate any differently in a motor than they were demonstrated by you with the experiments that you used? A. No, not with respect to circumferential flexibility.

Q. If you tested in a motor how can you determine their circumferential flexibility any better than you did if you didn't? A. I couldn't determine it any more positively to my mind, but one could mount the piston in a cylinder and find exactly what clearance is required in order to develop maximum power under hot motor conditions, and that clearance contrasted with the clearance of a trunk type piston under the same conditions should give a fair idea of the flexibility.

Q. Well, Doctor, why didn't you continue your tests and put them in a motor? A. Well, the Simmons suit was settled and I had a lot of other work to do at the time. I didn't do any more testing of these pistons after that.

Q. You were asked again regarding this Spillman & Mooers patent 1,092,870. You have read that patent over, haven't you? A. Yes.

Q. Do you find anything in there that justifies the splitting of the skirt longitudinally as shown in this Exhibit 3-P? A. No.

Q. Will you state whether or not the splitting of the skirt longitudinally as shown in Exhibit 3-P over the disclosure in the patent, affects the mode of operation and the results of the piston? A. Yes, it does.

Q. In what way? A. It makes a live piston out of a dead one, insofar as compensation for excessive expansion is concerned. It happens in that piston to produce a high degree of flexibility at the top of the skirt and a low degree at the bottom of the skirt.

Q. Would the piston even when split as in Exhibit 3-P, be a commercial piston, in your opinion? A. No.

Q. And why not? A. It is too heavy and too expensive to make.

Q. Now, these holes shown in the bosses in the Gulick patent, do you know whether they are oil holes or holes for set screws? A. Well, I can't say from the drawing, but there is no statement to the effect that they are one or the other, so far as I know.

Q. I call your attention to Fig. 1 and to the fact that there is a hole in the bottom of the boss, another hole in the top that leads to the point 22. Does that help you to determine whether that is an oil hole or is a set screw hole? A. Well, it is certain that the hole at the bottom of the boss would be put in in order to make possible the drilling of the hole at the top of the boss, so that it would be necessary to put holes through the boss in order to get the oil holes in in that construction.

Q. In other words, the holes at the top, marked 23, transmit the oil from spout 23 to the bearings? A. Yes.

Q. And then what would the holes in the bottom boss be for? A. Well, it could be an oil drain. In fact, it must, as I see it now, it must be an oil drain. And the fact that the boss is provided with oiling means, means that it is not locked in the bosses, otherwise there would be no necessity for oiling the boss bearings.

Q. Now, when you said that a piston could be made flexible at the bottom by a single slot, you were referring to the deposition Exhibit B? A. Yes.

Q. You said that this Exhibit 3-T corresponded substantially to the drawings of the Gulick patent. What

views of the Gulick patent did you mean when you said that? A. Figs. 1 and 2.

Q. Now, when you said yesterday that the Jardine was the first solution of the slapping and sticking piston problem, and Maynard was the second that you knew of, to what time were you referring? A. 1919-1920, approximately.

Q. At that time you hadn't learned of the Gulick type? A. No.

Q. Now, have you read the Ricardo article in this Exhibit 3-S, concerning which you were asked yesterday? A. Yes.

Q. Now, as a result of your testing the Ricardo piston, what would you say as to the language of that article in general? A. I would say that the article makes statements which are wrong and particularly extravagant with reference to the claims of the Ricardo piston, and perhaps misleading as to the value of the so-called crosshead type of piston referred to in the later part of the article.

Q. Take the statement appearing down near the bottom of the third column of page 274, which is as follows: "Experience has shown that with these divided slippers the clearance necessary can be reduced to about one-half of that required for the ordinary type, and to little, if any, more than is required for a cast iron piston." Did you find from your test with this Ricardo piston that the statements made therein are correct or not? A. They are wrong.

Q. Were the British engineers representing Mr. Ricardo present at the tests where you found that was wrong? A. Yes.

Q. Were they able to make those Ricardo pistons operate, as stated there? A. No.

Q. Have you now named all of the schemes that were tried out at the Aluminum Castings Company prior to the invention of the Jardine patent in suit in an effort to solve the problem that was solved by Jardine? A. No.

Q. Will you name any other schemes that were tried out to try to whip that problem at that time? A. Another way in which the problem was approached was to try to find a cylinder material which had approximately the same coefficient of thermal expansion as the aluminum alloy piston. To this end a motor was equipped with aluminum alloy sleeves or cylinder walls with the

same chemical composition as the piston itself, and the test was made to determine whether or not such a combination would be feasible. Although the combination worked for a time, before the test was completed the cylinder walls as well as the pistons, became sufficiently scored so that the plan was given up. I happened to have directed that test myself.

Another method used was to try to avoid the scoring by hardening the inside wall of the cylinder in some way. Electro-plating of the inside of the cylinder with iron was the means tried, and whereas this produced the desired result from the standpoint of co-efficient of expansion, and whereas some of the laboratory tests looked quite promising, it was also given up partly because of the chipping of the iron plating in places in some of the cylinder barrels, and also partly because the Jardine and Maynard solutions had come along in the meantime. It was also suggested as a means of overcoming this difficulty by C. Harold Wills, as I recall it, that the head of the piston could be plated with some bright metal which would reflect the heat from the explosion and the piston head would thereby be kept quite cool and the piston would not expand so much by virtue of its temperature. These plating ideas started during the war on the Liberty engine piston, but Mr. Wills still had the thing in mind and proposed it as a means of overcoming this difficulty, after the war was over.

Q. That was Wills of the Wills-St. Claire Company, wasn't it? A. Yes, formerly with the Ford.

Q. Have you named all you can think of? A. I don't recall any more schemes at the present time.

Q. You said something about the cross-head piston shown in this Ricardo article, Exhibit 3-8. Will you state whether or not any effort was made to employ that kind of scheme? A. Yes, the piston described in the Ricardo article at the end of the article was also represented to us by the Ricardo engineers as something having advantage, and the Aluminum Manufactures, Incorporated, actually designed and built a complete motor for the purpose of testing out that piston. It is not a conventional type of piston for internal combustion engines, hence a new motor had to be designed and built. The piston is long and heavy and is supposed to have its main bearing surface far removed from the head so that it can be kept cool during operation and the highly heated end is supposed to operate in another cylinder

higher up in the motor. That piston was tried out in this special motor and the motor was even put in the car and a road test was made and the piston and motor combination proved to be unsuccessful.

Q. Now, you spoke of the trial of the double-walled aluminum integral piston designed in an effort to keep the skirt walls cool and thus avoid expansion. Can you produce such a piston? A. I have such a piston in my hand.

Mr. Richey: I offer that piston in evidence as Plaintiffs' Exhibit 24.

Q. When was that piston tried out? A. I think about 1917.

Q. And by whom? A. The Aluminum Castings Company.

Q. Now, what was the result of the efforts of the trials of that piston? A. The piston couldn't be fitted as closely as was required and it was difficult to get a bearing of the skirt sufficiently rigid to keep the head sections from moving back and forth during the piston operation. This skirt is shown turned over to a point only slightly below the bottom of the boss. Pistons of this type, however, were made in which the skirt section was spun up practically to the ring groove section. Even such pistons did not function properly in the motor.

Q. You were asked about this piston, Exhibit B of the depositions: in your opinion, is that a commercial piston? A. No, that is not a commercial piston at the present time.

Q. And why not? A. Because it does not have the means for compensating for extra expansion at and near the top of the skirt.

Q. Will you state whether or not in your opinion that piston embodies the structure, mode of operation and results of any of the patents in suit? A. For practical purposes it has not.

Q. Well, does it for any purposes? A. Well, I had in mind that the flaring of the bottom of the skirt in this piston, deposition Exhibit B, is present and in so far as it takes place or would take place in this piston and would take place in the pistons of the patent in suit, there might be some similarity there.

Q. Well, you mean that one feature alone?

Mr. Bruminga: I object to that as leading.

A. That is it.

The Master: He has answered.

Q. Considering the patents in suit as a combination of elements operating to get a result, state whether or not you find any of those combinations in this Exhibit B? A. No.

Q. Now, you were asked about this Hartog patent, 1,842,022. State whether or not that piston has ever been used commercially to your knowledge. A. No, it has not, in my opinion.

Q. Is it, in your opinion, a commercially practical piston? A. No, I think it is not.

Q. Will you give your reasons for so saying? A. I think this Hartog piston is, among other things, entirely too flexible. It is designed to be put into a cylinder of smaller diameter than the skirt diameter itself, and the wrist pin supports in my opinion would be inadequate because the piston would be thrown from one side of the cylinder to the other by virtue of the high flexibility of the skirt. The piston has no rings and consequently it would not function properly from the standpoint of oil consumption, in my opinion.

Q. You were asked about this Exhibit 22, and particularly about the inclined relief shown at H. Can you tell from the drawing when that inclined relief was placed on the drawing? A. Yes, it was put on, according to the data on the drawing itself, on the 21st of February, 1925, and the item refers to "Their wire 2-19-25."

Q. And when was the drawing dated? A. The drawing is dated 9-1-23.

Q. Now, you testified that the pistons of Ricardo and Pomeroy patents were made in permanent molds with certain special inserts. Will you state whether or not that particular scheme you employed was commercial or whether you used it just for making experimental pistons? A. We used it at the insistence of the Ricardo representatives that the piston construction should be as nearly as possible that described by Ricardo, especially with respect to the location of the boss-supporting webs. The pistons so made up were merely samples and were never put in production.

Q. During your cross examination you were asked to and made a comparison of the Jardine and Ricardo pistons, in which you mentioned only the flexing of the skirt. Will you make a full comparison of these pistons

in structure, mode of operation, and results? A. The Ricardo construction shown in the Ricardo patent 1,294,833 is intended to be operated as a non-flexing device, both as regards the skirt and the webs. The proportioning of the web sections and skirt sections, and the location of such sections in Jardine, co-operate with the horizontal and vertical slots to produce flexibility and compensation for excessive expansion both by flexing of the webs and flexing of the skirt. When the Jardine construction is heated, the boss portion will be expanded more than the portion at right angles to the bosses. Such expansion will tend to bring the edges of the skirt sections outward and would produce scoring if it were not for the flexibility of the webs and the vertical slots making possible the flexing of the webs to relieve this excess pressure. There is no possibility of such compensation in the Ricardo construction because of the rigidity of said construction and because of the absence of the vertical slots. The Ricardo construction is therefore not made to compensate for this extra clearance, whereas the Jardine construction is. In other words, the proportion of the sections in Jardine and the proper location of the sections co-operating with the horizontal and vertical slots, puts flexing life into the piston of Jardine which is absent in Ricardo. The modes of operation are therefore different, and the results are different.

Mr. Richey: That is all.

RE-CROSS EXAMINATION by Mr. Bruninga.

Q. Just a few questions: you have not brought along any samples of the Jardine and Ricardo pistons, have you? A. No, I have not had an opportunity even to get over to my office during the recess.

Q. Now, I believe you stated that the separation of the head from the skirt in Mooers patent, together with the reliefs in the regions of the wrist pin bosses, enabled Mooers to reduce the clearance; is that right? A. Yes.

Q. You would expect that Mr. Ricardo to do the same thing, wouldn't you? A. No, it doesn't so operate. He has ample relief around the bosses, but he doesn't have it where it is most needed. As I compare the two constructions, the Ricardo relief does not extend around the connectors. The Ricardo relief only extends part way between the ends of these connectors.

Q. You mean the relief in the region of the wrist pin bosses? A. The relief around the junction of the connectors with the skirt portion. Of course also the Ricardo piston has the webs extending directly from the head rather than from the ring flange portions.

Q. And you think that makes the difference, whether you extend that from the head or from the ring flange? A. Well, that is a difference in the specific construction; but the reason I say Ricardo does not compensate for the extra expansion by relief, is that the extra expansion is greatest where the webs join the skirt section, and the effective skirt relief is on the boss, outer-end direction from such connections.

Q. What do you mean,—the connections are too wide? A. I mean that the webs of Ricardo are so long and so proportioned with reference to the diameter of the cylinders, and so related to the bearing area of the skirt that their expansion tends merely to push the skirt opposite the webs more tightly against the cylinder wall.

Q. And that would not happen in Maynard? A. That would happen in Maynard to an extent, but Maynard has flexibility.

Q. Flexibility between the wrist pin bosses and the skirt section? A. Yes, and also some web flexibility at the top of the skirt.

Q. Some web flexibility at the top of the skirt? A. Yes.

Q. More web flexibility than Mr. Ricardo? A. Well, Ricardo has no web flexibility, because he has no place for the web to flex. He has the rigid, non-flexible structure, whereas Maynard has a flexing structure.

Q. Even a flexing structure at the top of the web? A. Yes.

Q. Even though it is connected along an entire chord, is that your idea? A. Yes, I consider that that is a flexing structure, and a flexing feature on Exhibit 1 and also on the side of the Maynard piston, taking the maximum thrust, that is, opposite the side where the vertical slot is placed there is compensation for extra expansion by means of the Mooers principle.

Q. But the length of the webs, the length of these webs C of Ricardo, is about comparable to the length of the web in Exhibit 1 or 17? A. I should say the length is somewhat more in the Ricardo construction, because the webs are disposed in the Ricardo construction in

such a manner as to hold the entire wrist pin very substantially within the outer diameter of the piston.

Q. Well, you say the connection of the webs C' to the piston is comparable with the length of the connection in Exhibits 1 and 17? A. I should say the Ricardo web was somewhat longer.

Q. It is considerably shorter compared with the diameter of the piston, isn't it? A. The web?

Q. Yes. A. I think not.

Q. The connection of the webs at these points where they join the piston? A. I should say at that point they are fairly comparable.

Q. Now, the use of an aluminum sleeve and an aluminum piston is about comparable to a steel skirt piston with a cast iron cylinder, isn't it? That is, both have substantially the same co-efficient of expansion? A. Yes.

Q. And you don't know whether any steel skirt pistons are actually on the market today, steel skirt and aluminum head? A. Oh, no, no such pistons are on the market, at least not within my knowledge.

Q. Not even for replacement purposes? A. Not so far as I know.

Q. Now, you called attention to the electroplating of cylinders. That was copper-plating, wasn't it, of the inside of the cylinders? A. No, that was iron plating.

Q. Iron plating of the inside of the cylinders? A. Yes.

Q. Plating the inside of the iron cylinder with iron? A. No; plating the inside of an aluminum alloy cylinder with iron.

Q. You know the General Motors plates the cast iron pistons with copper and then with tin, don't you? A. Well, I didn't know they plated them with copper. I believe that the outside coating, at any rate, is tin.

Q. And General Motors still uses cast iron in all of its pleasure cars? A. Yes.

Q. So they are still working on the problem today, aren't they? A. Yes.

Q. The problem of using something else but aluminum pistons? A. No; they are working on the whole motor problem; pistons and everything else, and trying to make all things either as cheaply as they can or as good as they can and generally speaking to get the best results for a given amount of money.

Q. But General Motors is still working on this problem of keeping away from aluminum pistons? A. Well,

I don't know that they are working on the problem of keeping away from aluminum pistons. They aren't using aluminum pistons in their pleasure cars at the present time, and I presume they are doing work on pistons.

Q. That plating of a cast iron piston was a rather recent development, wasn't it? A. I don't know when it was developed.

Q. Well, it was since the Maynard patent came into use, wasn't it? A. The commercial application of it certainly was, so far as I know.

Q. You said the Hartog patent is entirely too flexible. You then can make the webs and the skirt too flexible, can you? A. Yes.

Q. You make it a particular point that Hartog has no piston rings at the top and therefore that is one of the disadvantages of the piston? A. Oh, I should think the piston would be inoperable from that standpoint alone, if from no other.

Q. Now, Exhibit 22, as you read, bears the notation "Their wire." Do you know what that wire refers to? A. Why, I imagine it refers to a wire from Willys-Overland Company to change the blue-print in a certain manner.

Q. It was a hurry-up call, wasn't it?

Mr. Richey: I object. He doesn't know; he is just imagining.

Mr. Bruninga: Well, he can only state if he doesn't know.

A. I think not. Those messages are frequently sent by wire or even long distance 'phone.

Mr. Bruninga: That is all.

Mr. Richey: That is all.

(Thereupon adjournment was taken to 9:30 a. m. of the following day.)

(At 9:30 a.m., Wednesday, January 25, 1933, the hearing was resumed. Harold H. Burton also appearing for the plaintiffs.)

Mr. Richey: I would like it to appear on the record that there were involved in the Summons suit eight patents, of which the Franquist was one, and all eight were admitted to be valid and infringed in the consent decree.

The Master: When was that decree entered?

Mr. Richey: That decree was entered September 25, 1931.

Of the patents in suit pending now before this master, there were in the Simmons suit the Schmiedeknecht patent, the Mooers, the Maynard, the Jardine and the Gulick patents, that is, all of the patents in the suits now at bar were in the Simmons suit.

Mr. Bruninga: And in addition to that the Spillman & Mooers patent 1,092,870 and the Franquist patent 1,153,902, and the Howdeshell reissue patent 16,273.

Mr. Richey: I think perhaps it would be helpful if I offered in evidence a copy of the consent decree in the Simmons case, which I now do as Plaintiffs' Exhibit 25.

Thereupon the Plaintiff called as a witness A. J. PERFLER, who, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Burton.

My name is A. J. Perfler, and I am Assistant Trust Officer of The Cleveland Trust Company, in Cleveland, Ohio. As Assistant Trust Officer of The Cleveland Trust Company my duties have to do with the administration of corporate trust estates, particularly patent estates. I am familiar with all the trusteeships of patents that are administered by The Cleveland Trust Company. There is but one trusteeship relating to automobile pistons held by The Cleveland Trust Company; it is called the L. P. Mooers piston patent estate and was created on March 7, 1922.

I am familiar with the relation of The Cleveland Trust Company to the patents in suit, identified as follows: Gulick patent 1,815,733; Jardine patent 1,763,523; Maynard patent 1,655,968; Schmiedeknecht patent 1,256,265; Mooers patent 1,402,309. These patents are included in the Mooers patent trusteeship administered by The Cleveland Trust Company. The Cleveland Trust Company has no other relation to the patents in suit except through its ownership of them under this trusteeship.

Plaintiffs' Exhibit 26 is the original signed Conveyance, Declaration of Trust and Agreement between L. P. Mooers and George Pitta, and The Cleveland Trust Com-

pany, dated March 7, 1922. That instrument, dated March 7, 1922, is now in effect and it sets forth the entire terms of the trusteeship under which The Cleveland Trust Company holds title to these patents in suit.

Mr. Burton: I offer this instrument in evidence as Plaintiffs' Exhibit 26, and request the privilege of withdrawing the original and substituting a printed copy.

The Master: It may be so received.

(Narrative continued) Additional patents have been acquired by The Cleveland Trust Company and placed under that trust, in the following manner: One by purchase. My recollection is they have purchased eight or nine patents outright. Another is by assignment; some of them from the Aluminum Company of America, some from Bohn Aluminum & Brass Corporation, and some from H. J. Hater, of Cincinnati, of Aluminum Industries, Inc.

The trust agreement recites the patents included in the trust estate, at its inception, and then provides for the acquisition of the patents as after-acquired property.

Provision D-5 in the trust agreement, reads:

"Subject to the conditions and provisions hereinafter set forth, the trustee shall be and is hereby authorized and empowered as follows: 5. To acquire, and receive the title to and licenses under inventions of improvements, applications for Letters Patent, and Letters Patent which upon their acquisition shall be included within the term 'property' as used herein."

There is no identification placed upon the patents when they have been acquired pursuant to that provision or others in that trust instrument; the patents acquired are not earmarked in any way at all; they are simply taken by us and become part of the property which comprises the estate. They are assigned to The Cleveland Trust Company and then if they are intended to come within the trust instrument, are placed with those that are kept under the instrument. The only thing I have to do with the identification of those patents which are assigned to The Cleveland Trust Company and placed under this trust instrument, is to list them. I am familiar with all of the patents that have been acquired by The Cleveland Trust Company and placed under this trust instrument.

No such subsequently acquired property that is placed under the trust instrument is held under any different terms of ownership or control than the original property.

Mr. Bruninga: I would like to know if there is a writing on that; something in writing; an additional agreement, before the witness answers the question.

Mr. Burton: The witness has already answered that that instrument contains all the terms that now control the trusteeship.

Mr. Bruninga: I have let you go ahead and let him tell you what is in that instrument. I would like to have the witness say whether there is any other agreement. It seems to me from these other contracts that there is a supplemental agreement dated April 26, 1924, as specified both in Exhibits 4-D and 5-D.

Mr. Burton: I thought I covered that. I don't know what that is.

(Narrative continued) There is no supplemental agreement to this trust agreement that I know of.

Without critically examining Plaintiffs' Exhibits 2 and 2-B, I know that this is the assignment from Packard Motor Car Company of the Gulick patent, and this is the original Gulick patent. Exhibit 2-B is the assignment from the Packard Motor Car Company to the Cleveland Trust Company of the Gulick application. That represents the only assignment that has been made of that patent to The Cleveland Trust Company.

Exhibit 3-D, attached to Plaintiffs' Exhibit 3, is the assignment from the Aluminum Company of America to The Cleveland Trust Company of the Jardine patent, and this is the original Letters Patent. The assignment from the Aluminum Company covered the applications for patents issued. That is assigned to The Cleveland Trust Company as trustee with directions to issue the patent to The Cleveland Trust Company as trustee.

The provision in Exhibit 3-D stating that the conveyance was to The Cleveland Trust Company as trustee under the said conveyance, declaration of trust, and agreement dated March 7, 1922, is the only assignment of this patent to The Cleveland Trust Company.

Plaintiffs' Exhibit 4-D, attached to Exhibit 4, is an assignment of the Aluminum Company of America's interest in the Maynard patent to The Cleveland Trust

Company as trustee, and this is the original Maynard patent that was issued.

It doesn't so state in the assignment of The Aluminum Company of America, but it states in the recitation clause that the Aluminum Company of America has had assigned to it one-half of the right, title and interest in the Maynard patent, and that is the interest which they conveyed to us by that assignment. That assignment, known as Exhibit 4-D, is the only assignment of the interest of the Aluminum Company of America under this trust to The Cleveland Trust Company.

Exhibit 5-D, attached to Plaintiffs' Exhibit 5, is an assignment of the Schmiedeknecht patent from Bohn Aluminum & Brass Corporation of Detroit to The Cleveland Trust Company and this is the original Letters Patent covering the Schmiedeknecht patent. The provision in the instrument of assignment, Exhibit 5-D, stating that the assignor does hereby sell, assign, and set over to The Cleveland Trust Company the whole right, title, and interest in and to said Letters Patent, is the only instrument of assignment by which The Cleveland Trust Company holds title to this patent. This patent is administered by me as a part of the Mooers patent trust that I referred to.

Exhibits 6-B and 6-C, attached to Plaintiffs' Exhibit 6, are two assignments: one from George B. Pitts to The Cleveland Trust Company of an undivided one-half interest (referring to Defendants' Exhibit 6-C); and the other of Louis P. Mooers, of an undivided one-half interest to The Cleveland Trust Company in patent 1,402,309, covering pistons (referring to Defendants' Exhibit 6-B). There are no other assignments under which The Cleveland Trust Company claims title to the Mooers patent than those I have just examined.

The trust estate does not own any patents relating to molding or molding machinery relating to pistons. If I may be permitted to go back to that point as to from whom we had acquired patents, I failed to include the Packard Motor Car Company, in listing those from whom we had acquired patents in suit. I wish to list the Packard Motor Car Company.

Mr. Burton: That is all.

CROSS EXAMINATION by Mr. Bruninga.

The trust estate holds no molding machine patents or molding patents; it simply holds piston design patents per se. The reason for that limitation is that is the nature of the estate; does not include anything else.

Exhibits 3-D and 4-D each mention a supplemental agreement dated April 26, 1924, and 4-D provides:

"The patent rights transferred hereunder are included by the Cleveland Trust Company in a certain license agreement dated April 26, 1924, wherein The Cleveland Trust grants *inter alia* a non-exclusive license to Aluminum Company of America under certain patents and applications, and the assignment made herein is made subject to the right of re-assignment under the terms and conditions provided in a certain so-called 'supplemental agreement' dated April 26, 1924 between The Cleveland Trust Company and Aluminum Company of America, and a letter of October 12, 1927, from the Aluminum Company of America to the Cleveland Trust Company."

That supplemental agreement dated April 26, 1924 is a supplement to the license agreement to Aluminum Company of America; it has nothing to do with the trust estate agreement.

Q. Well, that is your opinion. I would like to have it produced anyway.

Mr. Burton: You ask to have that produced along with the others for your examination and the master's examination to see whether they are material.

Mr. Bruninga: And the same with the letter of October 12, 1927, from Aluminum Company of America to The Cleveland Trust Company, and if there are two letters and two supplemental agreements on that date, one relating to each agreement, I would like to have those produced also. And of course also the particular license of April 26, 1924 mentioned in each agreement.

(Narrative continued) In addition to the agreements mentioned, that are listed in Exhibits 3-D and 4-D, that relate to the Maynard or Jardine patents, there is a Bohn license. There are no other agreements between The Cleveland Trust Company and Aluminum Company of America.

All the patent titles came to us by assignment. I said some were purchased. I did not intend to make any distinction between the patents that were purchased and the ones that were obtained by assignment, except this: that those patents that were in the estate at the inception weren't purchased. We purchased only those subsequently acquired after the trust estate was created.

The Mooers, Schmiedeknecht and Gulick patents are assigned directly to The Cleveland Trust Company, while the Jardine and Maynard patents (referring only to one-half interest in the Maynard patent) is to The Cleveland Trust Company, trustee. I know there is no distinction; the titles are both held for the same purpose and for the same end, in the same way.

The Cleveland Trust Company owns eighty patents in this estate, and twenty-three applications. There is a list here of those eighty patents, and I can produce it.

Q. I am not asking for the applications.

Mr. Burton: This again, I think, is clearly going into that field of bringing this trusteeship of The Cleveland Trust Company in here far beyond anything that relates to the case; it is perfectly immaterial whether they granted ten other licenses or fifteen other licenses, as far as affecting its title, which is the question to which the witness testified.

Mr. Richey: I object to the question as immaterial. The only question this Court is concerned with as far as title to these patents is concerned, is as to those in suit.

The Master: How is it material?

Mr. Bruninga: Your Honor will notice there has been talk about our infringing an additional patent, and this witness is not placed on the witness stand as an officer, and there certainly is no harm in giving us a list of patents that The Cleveland Trust Company owns. Furthermore he volunteered they owned eight or nine patents by outright purchase. He brought the matter up himself, and seems to make some point about that.

Mr. Richey: As far as that additional Franquist patent is concerned, we have told you that The Cleveland Trust Company owns that. If the rule was that evidence should be let in just because counsel see no harm to it, there is no end to our case.

(Further argument had by counsel.)

The Master: I think I will ask counsel for plaintiffs to permit Mr. Bruninga to examine this list before I let it in, to see whether there is anything pertinent to this suit. If it is pertinent to this suit, perhaps it is admissible, but I don't want it to go to a great extent.

Mr. Richey: We submit the list to opposing counsel.

Mr. Bruninga: I would like to look at this in connection with the licenses. I don't want to bring in anything that is not material at all.

(Short recess taken.)

Mr. Bruninga: Now, this Plaintiffs' Exhibit 3-C offered in connection with the Jardine patent refers on page 4 to licenses to Walker M. Levett, copies of which are attached to and marked Exhibits II (5) and II (6). I ask for the production of those licenses under the same conditions as the others. Then page 5 refers to an outstanding license to National Piston Company a copy of which is attached hereto and marked III (1) and which is not attached, and I ask for the production of that license. Pages 5 and 6 refer to an outstanding transferable non-exclusive license to the Kant Skore Piston Company, stated to be marked Exhibit IV (1), a copy of which is stated as being attached to the agreement, and I ask for the production of that. Page 11 refers to a list dated July 1, 1922, and which provides for re-assignment of the patents enumerated, including the Jardine patent in suit. I ask for the production of that list. The licenses are of course on the question of public acquiescence. The last refers to the question of title.

I may say, your Honor, on the question of title that while there may be an outright assignment, there may be a supplemental agreement which absolutely affects the assignment. There was a recent case in the 50 F. (2d) that passes on that very question (Six Wheel Corp'n. v. Sterling Motor Company). (Further remarks made by counsel.)

The Master: It is understood they will be produced under the same conditions.

Mr. Bruninga: That is all.

Re-Cross Examination by Mr. Bruninga.

The Gulick patent was an acquisition by assignment. If that is the distinction that you are making, whether we parted with any money for the patent. We paid no money for the patent—no money out of the estate for the patent. The patent was given to The Cleveland Trust Company for value received. Packard had an interest in the estate. Packard owned 600 shares of the estate out of 4512½.

I will just list the names of the beneficiaries of the estate:

Bohn Aluminum & Brass Company, 1100 shares;
Aluminum Company of America, 1100 shares;
Packard Motor Car Company, 600 shares;
E. R. Alexander, 350 shares;
H. J. Hater, 50 shares;
Adolph Nelson, 712½ shares;
L. P. Mooers, 600 shares.

I understand Mr. Nelson owns patents on strut pistons; I couldn't identify the patent or piston. Mr. Mooers is the Mooers of the patent in suit 1,402,309. Mr. Alexander is one of the directors of The Cleveland Trust Company. Mr. Hater is treasurer of Aluminum Industries, Incorporated, which company is a piston manufacturer and a sub-licensee under the patents in suit.

Mr. Bruninga: That is all.

Mr. Richey: I think we are through. What do you want to do about producing these documents? Do you want us to keep our prima facie open until you look them over?

Mr. Bruninga: Well, I want to call him back for cross-examination after I have looked them over.

(Thereupon noon recess taken.)

(At 1:30 p.m. Wednesday, January 25, 1933 the hearing was resumed.)

Mr. Richey: Plaintiffs rest.

Mr. Bruninga: Your Honor, we would like to proceed with the reading of the depositions in this case. I think it would be well to read them to connect up with the rest of the matter.

Mr. Richey: I think the matter should be noted that the Gulick application was filed November 30, 1917, and the Jardine March 11, 1920. Also a question on that final application I object to as not set up in the answer. Sections 40 and 41 are on the general issue which makes the application only competent on the question of invention and not on the question of anticipation. And you perhaps also would be interested in knowing that this controversy on prior art between Gulick and Long was fought out in the Patent Office and decided in favor of Gulick. We have here the Patent Office record which we will mark for identification and will come in later.

Mr. Bruninga: This whole matter of objection relates to what is to be done with the evidence rather than its admissibility; your Honor understands that.

The Master: I understand that it is all here, you have taken it, and I will pass on the question of its admissibility when I dispose of the case.

Mr. Richey: I just thought that perhaps that would make the evidence more intelligible to you.

Mr. Bruninga: It don't go to admissibility, but its application in this case.

(At this point the depositions of VERNER, CHADWICK, SUTTON, and GILBERT, Record pages 343 to 432, were read, and the testimony of MONCKMEIER, Record pages 292 to 313, HERBERT & GEORGE ELLINGHAM, Record pages 314 to 328, was taken.)

(9:30 a.m., Saturday, January 28, 1933, hearing resumed. Messrs. Richey, Watts and Burton appearing for plaintiffs; same appearances as last noted for the defendants.)

(Trust Estate contracts, licenses and agreements requested of witness produced for examination of the Master and Defendants' counsel, and discussion had between counsel as to admissibility of contracts and licenses.)

Mr. Burton: In response to request of counsel, we are glad to place these in the hands of the Court, and the Court I understand extends them to counsel for defendants, but not to put them to any inconvenience, examining them here, they can take them along with them. We would like to have the Court

make it clear these are at this point confidential documents, and counsel will not make photostats or copies of them, but they are to examine them at this time for the purpose of seeing what is in there.

The Master: That is the understanding; there is to be no copies made at this time, or they are to make no copies; it is just for examination only.

Mr. Bruninga: We may, however, reserve the right to make copies later.

The Master: That question will come before the Court later, but during this examination there are to be no copies made.

Mr. Sutherland: That is correct.

The Master: At this stage of the proceeding.

Mr. Bruninga: Does that mean we can make notations and hand them over to the Court?

The Master: Certainly.

Mr. Richey: And hand them back with the copies?

The Master: That is as I understand it. I think counsel understand the situation on both sides. These are strictly confidential papers at this time and are not being admitted in evidence, simply being examined by counsel.

Mr. Bruninga: Yes.

The Master: It is understood you can take these over Sunday.

Thereupon, A. J. PERFLER, being recalled, further testified as follows:

RE-DIRECT EXAMINATION by Mr. Burton.

I remember on cross examination, when I was last on the stand, I stated that one of the beneficiaries under the piston trust agreement was E. R. Alexander, and in response to a question by counsel for defendants, I stated he was a director of The Cleveland Trust Company. I would like to correct the impression as to the ownership of that stock; it is not stock but shares in beneficial interest. He doesn't have it as a director of The Cleveland Trust Company, and he does not hold it in any way for The Cleveland Trust Company.

RE-CROSS EXAMINATION by Mr. Bruninga.

Mr. Alexander holds those shares for himself. That is also true of Mr. Mooers. Both Mr. Alexander and Mr. Mooers personally draw the dividends on that stock. I wouldn't call them dividends; it is not stock. Returns on the beneficial interest have been declared, and they have been distributed to the various beneficiaries, including Mr. Alexander, Mr. Mooers, Bohn Aluminum & Brass Corporation, and all the other beneficiaries.

There is only one licensee besides Bohn, the Aluminum Company of America.

Those returns are declared quarterly, after setting up of a suitable reserve fund. It is not a declaration of dividends, you understand, it is a distribution of returns, to the various beneficiaries.

If you wish, you can say that the licensees, such as Bohn Company and Aluminum Company of America, get back some of the royalties they have paid; it is not a return to them as a licensee; it is a return to them as a beneficiary.

Mr. Bruninga: That is all. Except of course we might, after examining these licensees, like to ask Mr. Perfler some other questions.

The Master: That is understood. He has brought them here, and as I understand he is subject to call.

IN ANSWER TO QUESTIONS by Mr. Richey.

There are but two licensees under the patents, Aluminum Company of America, and the Bohn Aluminum & Brass Corporation. The Aluminum Industries, Inc. is a sub-licensee. There are but two people licensed by The Cleveland Trust Company, and the third is a sub-licensee.

(At this point the depositions of ROYALTY and STALLMAN, Record pages 432 to 436, were read, and the testimony of STALLMAN, Record pages 472 to 590 and D'VONSKY, Record pages 826 to 843, was taken.)

(At 9:30 a. m., Friday, February 3, 1933, the hearing was resumed. Mr. Burton also present, in addition to counsel last noted.)

Thereupon, A. J. PEARLEN, being recalled, further testified as follows:

CROSS EXAMINATION by Mr. Sutherland.

My name is subscribed to these various license agreements and so-called declarations of trust as Assistant Trust Officer of The Cleveland Trust Company. I didn't take part in the transactions and negotiations that were consummated in the trust agreements, and I wouldn't say that I took part in the license agreement negotiations. I am familiar with the agreements, with all the provisions.

I said that The Cleveland Trust Company had acquired eight or nine patents by purchase. (After checking patents in suit.) None of these patents here in suit were acquired by purchase. I wouldn't say that these patents or the applications filed that are here in suit were acquired by The Cleveland Trust Company in exchange for a certain number of shares in the trust estate. The Schmiedeknecht patent was acquired from Bohn, partly in exchange for a certain number of shares of the trust estate; there was an application in that exchange, as I understand the patents, only the patents are in suit. This Maynard came to us from the Aluminum Company of America. Under the license they were to assign, and the Jardine in the same manner, and the Gulick came from Packard, in exchange for a certain number of shares of the trust estate in addition to a couple of other patents.

I should say that it was the practice of The Cleveland Trust Company, in acquiring these patents for a certain number of shares in the trust estate, to transfer a number of shares more or less in accordance with the value of the patents or applications obtained.

I don't know that the Packard Company obtained 600 shares from the trust estate for the Gulick patent, the Church patent, and the Vincent patent. The Packard has 600 shares. The Gulick application was involved in part of the transaction, and also the Vincent patent. My recollection is the Church patent was also; I wouldn't say for sure. I don't know that as a matter of fact.

The Bohn Aluminum & Brass Company obtained 1512½ shares in return for the Schmiedeknecht patent and the Kent application. I don't know whether the Aluminum Company of America only obtained 1100 shares for several patents and a good many applications and an agreement to transfer every other patent relating to pistons per se that they obtained during the continuance of certain license agreements.

They obtained 1100 shares, but I don't know how they obtained them. I think that neither I, nor The Cleveland Trust Company have any other writing or record in our possession of that transaction.

The substance of the license agreement between the Aluminum Company of America and The Cleveland Trust Company is that Aluminum Company is obligated to transfer every patent relating to pistons per se that they ever obtain; during the continuance of the license agreements.

The Aluminum Company of America assigned several applications to The Cleveland Trust Company at the time the agreement was executed, and afterwards. I don't recall just how many were assigned. Included among those was the Jardine patent in suit, and subsequently a one-half interest in the Maynard patent was acquired. The Aluminum Company has 1100 shares in the trust estate.

This license agreement between The Cleveland Trust Company and the Aluminum Company of America (after examining same) covers about eight patents. They are cited in the agreement as follows: Spillman & Mooers, J. T. Vincent; H. C. Marmon; Harold D. Church; L. P. Mooers 1,347,819; L. P. Mooers 1,402,308; L. P. Mooers 1,402,309; and E. J. Gulick. Two of those patents are in suit, Gulick and Mooers.

The Mooers patent 1,402,309 and the application which later matured into the Gulick patent, are the only ones of the patents in suit named in the license agreement. The agreement covers other patents; it contemplates that the Aluminum Company of America shall assign all patents and applications covering the pistons per se; and it also contemplates that the Aluminum Company of America will be automatically licensed under any patents per se later acquired by The Cleveland Trust Company. The Cleveland Trust Company now owns about eighty patents relating to pistons, per se; and I should say that license agreement covers all of them. The point I want to make is that they are not named in the agreement. Now, this license agreement between The Cleveland Trust Company and the Aluminum Company of America is an exclusive license on everything except pistons made entirely of cast iron and steel.

Mr. Richey: I object to that. The license is the best evidence.

Mr. Sutherland: If your Honor please, I understand they don't want to put them in.

The Master: If you don't want to put the licenses in, I think he is entitled to ask that.

Mr. Richey: He doesn't know whether they are exclusive or not; whether they are exclusive or not is a matter of law.

The Master: Then the licenses will have to go in.

Mr. Richey: Then I think we will have to put the licenses in.

(Thereupon, further argument was had as to the introduction of the licenses.)

Mr. Sutherland: I will ask counsel to offer the agreement in evidence as one of plaintiffs' exhibits.

Mr. Burton: If the court please, these agreements were brought down here at the request of the defendants for their examination, if they want to put them in—we believe they are immaterial, as we have often said, but if they want to introduce that testimony for which they asked us, why, there it is.

The Master: As long as they go in evidence what difference does it make who offers them? They are here and they are exhibits. What difference does it make who designates them, if they produce them?

Mr. Sutherland: The defendants will offer them.

Mr. Burton: We note our objection on the ground that we consider them as immaterial.

Mr. Sutherland: I offer in evidence the license agreement between The Cleveland Trust Company and Aluminum Company of America as Defendants' Exhibit 4-S.

The Master: It may be received.

(Narrative continued) Defendants' Exhibit 4-S, which I have just examined, was executed April 26, 1924.

It is correct that the Aluminum Company of America agreed in that agreement to assign to The Cleveland Trust Company all patents and all applications for patents relating to pistons per se which were thereafter acquired by it.

Defendants' Exhibit 4-T, which has been handed me, is the supplemental agreement between The Cleveland Trust Company and Aluminum Company of America, dated April 26, 1924. In paragraph 3 of this supplemental agreement, identified as Defendants' Exhibit 4-T, I find reference made to license agreements with the

Walker M. Levett Company and the W. M. Levett Corporation of New York; also the National Piston Company, Incorporated, of New York, and also the Kant Skore Piston Company of New York, and copies of these license agreements are said to be attached hereto as Exhibits E, F, and G. Exhibits E, F, and G are so attached. On the other hand, taking first Exhibit E, which is the license agreement between The Cleveland Trust Company, and the Walker M. Levett Company, it refers to a sub-license from the Aluminum Company of America to the Walker M. Levett Company said to be attached hereto and marked Exhibit B. Exhibit is not attached to this agreement. That so-called Exhibit B is not, and never was in the possession of The Cleveland Trust Company.

I signed this license agreement, Exhibit E, as assistant Trust Officer of The Cleveland Trust Company. Under paragraph 4 of that Exhibit E, which forms a part of the supplemental agreement, Defendants' Exhibit 4-T, The Cleveland Trust Company obligates itself in the event of cancellation of the so-called Exhibit B. I didn't say we didn't examine Exhibit B.

Before, when I said The Cleveland Trust Company never had Exhibit B in its possession, I didn't understand the question. Of course we examined them. I thought you said was it in our possession as a record. I can't say how long it has been since we had it; it has not been recently. I don't know where it is now.

The same thing applies to the National Piston sub-license, and also the Kant Skore sub-license.

Article 3 of the agreement dated April 26, 1924 between The Cleveland Trust Company and the Aluminum Company of America described as supplemental agreement, and provides:

"In case the license agreement is cancelled for any reason whatsoever other than because of failure of the licensee to carry out its obligations or any of them to the licensor thereunder, the licensor agrees to re-assign to the licensee all patents, patent applications, or other patent rights which have been assigned to the licensee from the licensor under said license agreement (Exhibit D) attached hereto, subject, however, to any and all licenses and sub-licenses which have been granted either by the licensor or the licensee or which the licensor is under contract to grant with respect to said patents, patent applications or other patent rights to (1) Walker M.

Levett Company and W. M. Levett Corporation of New York; (2) The National Piston Company, Incorporated, of New York; and (3) The Kant Skore Piston Company of Cincinnati, Ohio, copies of which contracts are hereto attached and marked Exhibits E, F, and G, respectively."

There are no other agreements or understandings between The Cleveland Trust Company and the Aluminum Company of America with reference to the patents in this piston trust estate, written or verbal. These two agreements, Defendants' Exhibit 4-S and the supplemental agreement, Defendants' Exhibit 4-T, represent all the features of the relation between The Cleveland Trust Company and the Aluminum Company of America with reference to this piston trust license agreement and the supplemental agreement. There are no others.

I have an executed copy of the agreement between Bohn Aluminum & Brass Company and The Cleveland Trust Co. (Witness produces same.)

Of the patents owned by The Cleveland Trust Company which I produced, I don't know whether or not The Cleveland Trust Company has any right to make, use, sell, pistons or grant licenses under those patents or any of them. The Cleveland Trust Company has granted licenses other than this license to the Aluminum Company of America under those patents. We obtained the consent of the Aluminum Company of America before granting that license to Bohn Aluminum & Brass Corporation, and it is the only one. As to whether or not The Cleveland Trust Company could grant that license until consent was had from the Aluminum Company of America, I don't know, but I know as a matter of fact that we didn't grant it until we obtained their consent.

The instrument marked for identification as Defendants' Exhibit 4-U is a license agreement from The Cleveland Trust Company to Bohn Aluminum & Brass Corporation dated as of September 15, 1927, actually executed October 12, 1927. An amendment to the license agreement dated April 25, 1928, as of January 1, 1928, was also found bound with that license agreement. I also find bound up with that a consent of Aluminum Company of America to licensing Bohn Aluminum & Brass Corporation to make, use and sell a maximum of eleven million pistons during the accounting year 1929. I find nothing else bound there with it.

Referring to the first page in that bound instrument, that is a consent of Aluminum Company of America, addressed to The Cleveland Trust Company, trustee, to execute the carrying out of agreement dated October 12, 1927 between The Cleveland Trust Company as trustee and the Bohn Aluminum & Brass Corporation.

Referring to the second page of that instrument, this is a letter addressed to The Cleveland Trust Company, trustee, by Aluminum Company of America, dated October 12, 1927, supplementing the letter of September 19, 1927. It reads:

"We beg to say that it is understood and we hereby agree that in case we surrender the license heretofore granted to us by you under date of April 26, 1924, any reassignment of the patents, patent applications, or other patent rights which have been assigned by us to you under said license agreement, shall be made subject to the license granted by you to the Bohn Aluminum & Brass Corporation by the agreement executed this date between you and the Bohn Aluminum & Brass Corporation, the execution of which on your part we consented to in our letter of September 19, 1927."

I don't know whether Bohn wouldn't sign that license agreement until we had some sort of release from the Aluminum Company of America.

I do find bound in that instrument a letter written on the letterhead of the Aluminum Company of America. I might add that the letter I have just quoted was apparently written in Detroit, Michigan.

The substance of the letter written on the letterhead of the Aluminum Company of America is:

"We beg to advise that we recognize that the commercial controlled type piston heretofore manufactured or for which castings have heretofore been manufactured by us are covered by claims of one or more of the patents included in this or to be attached hereto."

Controlled type pistons are those which employ the so-called strut. I want to say that is my understanding; I don't know that, of course. I don't know if Defendants' Exhibit AAA is such a piston.

There are particular patents referred to in that letter from the Aluminum Company. There are the lists attached to the letter. I don't recall whether or not the

lists A and B attached to that letter, represent every patent and patent application owned by The Cleveland Trust Company at the time that letter was written.

Q. I will ask you to compare those lists A and B with the lists A and B which are appended to the Bohn license agreement. Perhaps counsel will admit they are the same.

Mr. McCoy: Have you compared them?

Mr. Sutherland: Yes.

Mr. McCoy: They speak for themselves, then.

Mr. Richey: Subject to correction if we find any error.

(Narrative continued) I don't know whether the Bohn Aluminum & Brass Corporation would not sign this license agreement until the Aluminum Company of America admitted for all practical purposes that these so-called commercial controlled type pistons were covered by one or more patents owned by The Cleveland Trust Company.

I did not state that I took part in the negotiations which led up to these license agreements.

There is no other agreement between Bohn Aluminum & Brass Corporation and The Cleveland Trust Company, written or oral. There is no understanding between them. I do not know of any other agreement, whether written or oral, between Bohn Aluminum & Brass Corporation and the Aluminum Company of America.

Mr. Sutherland: I will ask counsel for plaintiffs to offer in evidence these agreements identified as Defendants' Exhibits 4-T and 4-U.

(After conference between counsel for plaintiffs, Mr. Burton examined the witness as follows:)

Defendants' Exhibit 4-T, which has been marked for identification, is the supplemental agreement dated April 26, 1924 between The Cleveland Trust Company and the Aluminum Company of America. I can identify this as the original instrument. The papers attached to the instrument which I have just identified are attached and referred to in the agreement as being a part of the agreement Exhibit D, which is a license agreement between The Cleveland Trust Company and Aluminum Company of America dated April 26, 1924. Those are copies of the instruments. Exhibit E, an agreement dated

April 11, 1924 between Walker M. Levett Company and W. M. Levett Corporation and Walker M. Levett and The Cleveland Trust Company; an agreement marked Exhibit F, dated April 11, 1924, between The National Piston Company, Gustave E. Franquist, James E. Diamond and the Cleveland Trust Company; an agreement marked Exhibit G, dated April 11, 1924, between the Kant-Skore Piston Company and The Cleveland Trust Company.

Mr. Burton: Plaintiffs will offer as an exhibit the instrument identified as Exhibit 4-T as Plaintiffs' Exhibit 38, and will identify for the purposes of reference that exhibit as embodying 38a, the agreement between The Cleveland Trust Company and Aluminum Company of America, and 38b the copy of the license agreement between The Cleveland Trust Company and the Aluminum Company of America; 38c, copy of license agreement between Walker M. Levett Company and W. M. Levett and The Cleveland Trust Company dated April 11, 1924.

Mr. Sutherland: I will admit that 38b is the same as Defendants' Exhibit 4-S, dated April 11, 1924.

Mr. Burton: As 38d, copy of license agreement between The National Piston Company and James A. Diamond and The Cleveland Trust Company dated April 11, 1924; as 38e, copy of license agreement between the Kant-Skore Piston Company and The Cleveland Trust Company dated April 11, 1924.

I offer those in evidence on behalf of the plaintiff with permission to substitute a copy of them.

Mr. Sutherland: A photostatic copy, provided you give us a photostat of it. The same thing applies to Defendants' Exhibit 4-S.

The Master: That is as to photostatic copies.

Mr. Burton: For the purposes of the record it had better stay like it is here, on account of their all being attached as a part thereof.

(Narrative continued) Defendants' Exhibit 4-U are the original instruments; I know that they are.

Mr. Burton: Your Honor, I offer in evidence on behalf of the plaintiff the several parts of Defendants' Exhibit 4-U, identifying them as follows: Plaintiffs' Exhibit 39a, letter from Aluminum Company of America to The Cleveland Trust Company,

dated September 9, 1927; Plaintiff's Exhibit 39b, original letter from the Aluminum Company of America to The Cleveland Trust Company, dated October 12, 1927; Plaintiffs' Exhibit 39c, original license agreement between The Cleveland Trust Company and Bohn Aluminum & Brass Corporation, dated September 15, 1927; Plaintiffs' Exhibit 39d, original letter from Aluminum Company of America to Cleveland Trust Company dated September 19, 1927, referring to commercial controlled type piston heretofore manufactured; Plaintiffs' Exhibit 39e, original letter from Aluminum Company of America to The Cleveland Trust Company, dated April 26, 1928; Plaintiffs' Exhibit 39f, original agreement between The Cleveland Trust Company, trustee, and Bohn Aluminum & Brass Corporation dated April 25, 1928, as of January 1, 1928; Plaintiffs' Exhibit 39g, original letter from the Aluminum Company of America to The Cleveland Trust Company, trustee, dated December 24, 1929, with the understanding there is authority to substitute photostatic copies for these instruments.

Mr. Sutherland: Provided we have a copy.

(Thereupon short recess taken.)

(Narrative continued—In response to questions by Mr. Sutherland.) Referring to Plaintiffs' Exhibit 39c, the license agreement, I do not know why those patents were listed separately; I wouldn't care to say without checking into the records; I wouldn't care to trust to my recollection about it. There are upwards of thirty or forty patents there, and I wouldn't care to say without checking the agreements. I am acquainted with these agreements, but I don't know why these patents were listed separately.

I testified that the Jardine patent here in suit was acquired from the Aluminum Company of America. The application for that patent, Serial No. 450,598, was listed in list B. The Gulick application and the Moore patent were not obtained from the Aluminum Company of America, the Gulick application being Serial No. 304,661, and they were listed in list A.

I don't know if there has been any change in the title to the patents listed in list B since this Bohn license agreement was entered into; I would be familiar with it if there were any. So far as I know, the patents listed

in list B are held in the same way today as they were on October 12, 1927; there has been no material change; there has been no change in this agreement, if that is what you mean.

If the Bohn Aluminum & Brass Company knew at the time that license agreement was entered into, how The Cleveland Trust Company held title to those patents, I don't know it. I don't know whether or not there was any representation made to them.

Referring to the first "whereas" clause of the license agreement, Plaintiffs' Exhibit 39c, the statement: "Whereas Licensor * * * has arranged to acquire the entire right, title and interest in and to the Letters Patent and applications set forth in list B," says that The Cleveland Trust Company has arranged to acquire them.

Q. At that time The Cleveland Trust Company didn't own the application for the Jardine patent which is listed in list B? A. Whatever the agreement recites is a fact.

Mr. Richey: The assignment in evidence will show that.

Mr. Sutherland: The agreement is contrary to it.

Mr. Richey: Well, that is a matter of argument, if you think so; but when The Cleveland Trust Company acquired this Jardine patent is a matter shown by the exhibit, which is the assignment which is already in evidence.

Q. I call your attention to Plaintiffs' Exhibit 3-D, which purports to be an assignment of the Jardine application to The Cleveland Trust Company, and ask you when that was executed.

Mr. Richey: Doesn't that show?

Mr. Sutherland: It does show.

Mr. Richey: Well, I object; it has not been shown that this witness would know any more than what is shown on the document.

Mr. Brunninga: I object to your telling this witness what he does and what he does not know.

The Master: He may answer.

(Narrative continued) The date appearing on this instrument as its date of execution is May 13, 1930. The Cleveland Trust Company, at the time that license agreement with Bohn was entered into, I think did own the

Jardine application, by virtue of the agreement, which is the license agreement between The Cleveland Trust Company and the Aluminum Company of America.

I am not prepared to say whether or not The Cleveland Trust Company claims title under this assignment of Exhibit 3-D, or under the license agreement; that is a legal question, and I wouldn't care to say. I have recited the fact when the assignment is dated.

The Cleveland Trust Company, at the time of entering into the license agreement with Bohn Aluminum & Brass Corporation, held title to the Jardine application under the clause in the agreement under which Aluminum Company of America was bound to assign them.

It is also a legal question whether The Cleveland Trust Company owned the Jardine application before this assignment Plaintiffs' Exhibit 3-D was made; I don't know.

I do not know why Section 1 of this license agreement with Bohn Aluminum & Brass Corporation, Plaintiffs' Exhibit 39c, limits the Bohn Company to five million pistons and piston castings per year, now I understand extended to ten million.

The limitation of five million pistons and piston castings includes the so-called commercial strut type piston.

There is a provision in this agreement which states that the Bohn Aluminum & Brass Corporation admits for all practical purposes that the commercial controlled type pistons are covered by some one or more patents owned by The Cleveland Trust Company; there is a letter attached to the agreement, from the Aluminum Company of America, according to my recollection.

Section 6 of the license agreement from The Cleveland Trust Company to the Bohn Aluminum & Brass Corporation recites, "For the purpose of the interpretation of the provisions of this agreement, it is agreed that the commercial controlled type pistons heretofore manufactured or for which castings have heretofore been manufactured by Bohn Corporation and Aluminum Company of America are covered by claims of the patent included in lists A and B hereto attached. That means the patents listed in lists A and B hereto attached.

The Cleveland Trust Company does not own any patents relating to pistons *per se* other than those listed in the lists I furnished the other day, that is up to the date of December 10, 1932.

The Cleveland Trust Company does not own any interest in any other patents relating to pistons, *per se*;

nor does The Cleveland Trust Company have any licenses under any patents other than the Maynard patent here in suit.

The Cleveland Trust Company is not interested in any way in any patents or applications for patents of Adolph Nelson. The Bohn Aluminum & Brass Corporation pays one cent on each of the so-called commercial controlled type pistons; there is none of that refunded. I don't know whether or not that accounts for why the Bohn Aluminum & Brass Corporation received 1500 shares of the trust estate, because of the Schmiedeknecht patent and one application, while the Packard Motor Company received only 600 shares for the Gulick application and two patents.

I don't know whether or not The Cleveland Trust Company only has title to the Jardine and Maynard patents so long as the license of the Aluminum Company of America remains in force.

I know there is a provision in the supplemental agreement for reassignment of all the patents and applications retained by the Aluminum Company of America upon the expiration of the license agreement.

The Cleveland Trust Company has not been indemnified for the cost of the expenses of these suits.

The Cleveland Trust Company, trustee, is paying all the attorneys who represent The Cleveland Trust Company.

The Cleveland Trust Company did not have to obtain the consent of the Aluminum Company of America before these suits were brought.

These suits were not brought at the instance of the licensees of The Cleveland Trust Company to bring suit against the Sterling Products Corporation.

The titles to the Schmiedeknecht, Gulick and Mooers patents are held in the same way by The Cleveland Trust Company as the titles to the Jardine and Maynard patents.

The license agreement Plaintiffs' Exhibit 29 and the agreement marked for identification as Defendants' Exhibit 4-V, were consummated at approximately the same time.

Mr. Sutherland: I will ask counsel for plaintiffs to offer in evidence this agreement identified as Defendants' Exhibit 4-V.

Mr. Burton: If your Honor please, I would like to make a statement with regard to these exhibits

38 and 39 last offered, and this raises the same point again,—just so that it may be clear on the record, the plaintiffs are objecting to the materiality of Defendants' Exhibit 4-S, which relates to the license to the Aluminum Company of America. These instruments which are contained in Plaintiffs' Exhibits 38 and 39 depend for whatever materiality they may have upon the introduction and materiality of 4-S, and we are only introducing them at this time for the convenience of the court, and if the court should rule that Exhibit 4-S was immaterial, as we contend, that ruling should carry with it the exclusion of this 38 and 39 because we contend they have no materiality in the case; but for the convenience of the court and the examination of witnesses and so on, we permitted them to go in at this time.

The Master: I understood that.

Mr. Burton: But they are really a part of the same question of law.

The Master: They are received under the same understanding, Mr. Burton.

Mr. Burton: On that same basis, although we contend that this instrument here is even less material we are willing to introduce the instrument marked for identification by the defendants as 4-V, which is a photostatic copy of an agreement between the Bohn Aluminum & Brass Corporation and The Cleveland Trust Company dated October 12, 1927, that has not been introduced in evidence. Under the same limitations I will ask the witness whether he is able to identify that as a copy of the original instrument.

The Witness: Yes, it is a copy of the original instrument.

The Master: It may be received, under the same reservation.

Mr. Burton: And it will be marked as Plaintiffs' Exhibit 40. And for clarity, we will state in the record that the original instrument has attached to it a copy of the license agreement between The Cleveland Trust Company and the Bohn Aluminum & Brass Corporation, the original of which has been introduced as Plaintiffs' Exhibit 39-C, no date, which license agreement has been included in other exhibits and is not reproduced in the photostatic copy introduced as Plaintiffs' Exhibit 40.

Mr. Sutherland: I offer in evidence a list of patents which has been produced here by plaintiffs as Defendants' Exhibit 4-X. This list as I understand it, represents the patents that are owned by The Cleveland Trust Company, under the trust agreement, and relating to pistons *per se*.

FURTHER CROSS EXAMINATION by Mr. Bruninga.

I had nothing to do with the negotiations of the license agreement that was granted to Walker M. Levett, National Piston Company, and Kant Skore Company. There are no licenses from The Cleveland Trust Company to those parties. There were no licenses at all to those three parties. I had nothing to do with the negotiations of the licenses from the Aluminum Company of America to Walker M. Levett, National Piston Company, or the Kant Skore Company. I don't know that The Cleveland Trust Company assumed the responsibility for those licenses.

I don't recall the papers marked for identification Defendants' Exhibit 4-Y, including a bill of complaint and answer in Equity 2732, The Cleveland Trust Company vs. National Piston Company, Incorporated, which is attested by me as assistant trust officer. I do know that there was a suit filed against The National Piston Company, Incorporated, on a Spillman & Mooers patent, the Vincent patent 1,279,184, the Church patent 1,327,149, and the Mooers patent 1,402,309; the record shows that, and also that the case was dismissed. I wouldn't care to rely on my memory as to whether or not it was dismissed by The Cleveland Trust Company, it is some years ago. The answer in that case is dated September 15, 1923 and the license to the National Piston Company is dated April 11, 1924, but I don't know whether the dismissal of that suit and the license had any relation. We weren't a party to the license agreement.

Paragraph 3 of Exhibit 38-D reads as follows:

"In case the sub-license from the Aluminum Company of America to the National Piston Company, Incorporated, a copy of which is attached hereto and made a part hereof marked Exhibit B is cancelled or terminated for any reason whatsoever, excepting the failure of the National Piston Company, Incorporated, reasonably to comply with its obligations thereunder, and said The National Piston Company, Incorporated, forthwith applies to whom-

soever then holds or controls as owner or exclusive licensee the inventions or applications for Letters Patent and Letters Patent embraced by such sub-licenses, for another sub-license upon terms at least as favorable for The National Piston Company, Incorporated, as those in said sub-license B contained, and such owner or exclusive licensee, as the case might be, fails to execute or deliver to The National Piston Company, Incorporated, such a sub-license within thirty days from the date of such application by said The National Piston Company, Incorporated, then in that event this agreement shall be deemed and construed invalid to operate as such a sub-license having the terms and conditions of the said license Exhibit B applicable for such purpose, and the National Piston Company, Incorporated, shall account thereunder directly to the Trust Company."

The National Piston Company did account directly to the Trust Company since that time; it paid royalties under that sub-license.

I don't recall whether that suit was dismissed before or after this license. I didn't know at that time there was a suit against The National Piston Company on molding patents.

We granted no license to Kant Skore.

I don't know whether before agreement 38-E was entered into April 11, 1934, which bears my signature, there had been a suit against the Kant Skore Company for infringement of molding patents held by Aluminum Company of America. I don't know whether there was such a suit in 1933.

There was no co-operation, that I have knowledge of, between the Aluminum Company of America and The Cleveland Trust Company in the settlement of controversies with National Piston Company, Kant Skore Company, or Walker M. Levett Company. I didn't sit in any of those controversies at all.

Mr. Bruninga: That is all.

As I understand, counsel is willing to admit the authenticity of a copy of the bill of complaint in Equity 535, entitled The Cleveland Trust Company v. E. C. Long Piston Company and E. C. Long, filed in the United States District Court in and for the Eastern District of Michigan, and marked for identification Defendants' Exhibit 4-E.

Mr. McCoy: Are you willing to couple that up with the fact that the suit was dismissed because infringement ceased?

Mr. Bruninga: I am willing to couple it up with a stipulation that the suit was dismissed, but I don't happen to know why the suit was dismissed.

(Further remarks made by counsel, with no agreement reached.)

I will examine the witness on it if you don't want to admit the authenticity.

Mr. McCoy: Very well.

(Narrative continued, in answer to further questioning by Mr. Bruninga) That is my signature on the last page of Exhibit 4-Z. I knew that at that time suit was about to be filed against the E. C. Long Piston Company and E. C. Long, and I know that such a suit was filed. I executed that bill of complaint in that case. That bill of complaint included the Spillman & Mooers patent 1,092,870, the Vincent patent 1,279,184, the Church patent 1,327,147, and the Mooers patent 1,402,309. (Witness read bill to verify.) I have no reason to believe that is not a copy of the bill of complaint as filed.

Mr. Bruninga: I offer in evidence Defendants' Exhibit 4-Z.

(Narrative continued) I do not know what particular device Mr. Long and the Defendant, E. C. Long Piston Company, were making at that time which was alleged to be an infringement of the patent. I do not recognize Defendants' Exhibit FFF.

Mr. Bruninga: As I understand it, the plaintiffs' counsel know that that statement is correct, that Long discontinued the use of pistons because he proceeded to purchase castings from licensees under the patent.

Mr. McCoy: No; that is not correct. I understood that the E. C. Long Company originally made piston castings for themselves, in addition to those they purchased from licensed sources, and when they ceased to make the castings for themselves and bought the castings from licensed sources, the bill of complaint was dismissed.

Mr. Bruninga: I will take counsel's word for that understanding. Will counsel state whether this

particular device was alleged to infringe, Exhibit FFF!

Mr. McCoy: I couldn't say, because this device is a licensed casting, as shown by the marking on the casting as coming from the Walker M. Levett Company. They were licensed under the estate patents.

Mr. Bruninga: Counsel will not state whether it was or whether it was not the same general structure?

Mr. McCoy: I don't know.

Mr. Bruninga: I also offer in evidence Defendants' Exhibit 4-Y.

The Master: It may be received. We will recess now to 1:30.

(Narrative continued) With reference to Plaintiffs' Exhibit 38, the supplemental agreement between The Cleveland Trust Company and the Aluminum Company of America, the third page of that agreement in which it refers to copies of contracts hereto attached and marked Exhibits E, F, and G, Exhibit E refers to an Exhibit B. It also refers to Exhibit A. Neither of these exhibits are attached. Exhibit F in this instrument refers to Exhibit A, and Exhibit B, neither of which are attached. Exhibit G refers to Exhibit A and refers to Exhibit B, neither of which is attached.

Exhibit A of the above instrument is a copy of the original declaration of trust and agreement, and Exhibit B is a sub-license agreement from Aluminum Company of America to these various parties; there are three of them. There is no reason why they are not attached; they simply are not here. We didn't consider them of enough moment to attach them, because there are other places they are available to be referred to. The principal contracts referred to on page 3 of the supplemental agreement (after examining them) are complete with the exception of those exhibits. We could produce copies of the sub-exhibits if requested by counsel. We don't have the original agreement; we are not parties to them. There would be no objection, as far as we are concerned, to producing those agreements if counsel for the other side should request, that is, copies of them.

Mr. Bruninga: I would like to have you produce those copies for our examination, if you can produce them.

Mr. Burton: We have here a copy of the instrument referred to as Exhibit B, attached to Exhibit E, and a copy of the Exhibit B attached to the Exhibit G.

Mr. Bruninga: If you have them already in evidence—

Mr. Burton: These aren't in evidence. We don't regard them as material. If you want to do something with them, why here they are.

Mr. Sutherland: I would like the record to show that I made request to counsel a day or so ago to produce these and was advised they weren't available.

Mr. McCoy: Request was for the original agreement, to which The Cleveland Trust Company was not a party, and we did not have these agreements.

(Examination closed.)

(At 9:30 A.M., Thursday, January 26, 1933, the hearing was resumed. Thereupon, the remainder of the deposition of CHARLES L. CHADWICK was read, during which counsel for plaintiffs produced interference records in cases 2608 and 2609 in interference in the Patent Office.)

Mr. Bruninga: I object to their introduction.

Mr. Richey: I am not offering them; they were marked for identification. I call attention to them.

Mr. Bruninga: I am perfectly willing for counsel to introduce any particular depositions referred to later on in this deposition.

GUSTAVE C. MONCKMEIER, a witness called by Defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Bruninga.

My name is Gustave C. Monckmeier. I live in Davenport, Iowa. I am in the manufacturing business. I make automatic connecting rod bolts, automatic bearing caps, trunk racks, automatic windshield screens, bumper posts, and a variety of lines, also automatic hose clamps.

I am 44 years old.

In 1911 I had charge of the testing department of the Staver Carriage Company, Chicago. My principal duties were to have charge of the testing department, also some experimental work, also taking part in all the

1 races, plus the professional drivers that the Staver Carriage Company hired. I drove as a race driver in 1910 for the Staver Company.

I remember that there was a race in Elgin, Illinois, in the year 1911. It was August, 1911. I drove in that race. There was practicing for that race prior to that time. About seven or eight days previous to the race we was allowed to practice and test out motors, and so forth. My team mate Ralph Ireland got killed in that race.

I drove a Staver car in the Elgin race. It was an assembled car. We purchased the motor from the Teeter Motor Corporation. It had four cylinders. I remember the bore of the cylinders of the racing car that I drove. It was $4\frac{1}{2}$ x 5, $4\frac{1}{2}$ " in diameter and 5" in the stroke. That was exactly 300.7 cubic inches piston displacement. That piston was a trunk piston made out of cast iron, special light cast iron. The car was number 27.

Q. Can you describe the pistons that you used in that car in the Elgin races?

Mr. Richey: Is this set up in the answer?

Mr. Bruninga: No.

Mr. Richey: I object to it, then, as not being set up in the answer.

Mr. Bruninga: You cannot object to it as not being set up in the answer, you can object to its use later on, but there is no provision in any statute or any decision that provides the testimony cannot be admitted.

The Master: I will receive it. Objection will be overruled; same ruling.

Q. How was it constructed? A. Well, I used several different kinds. But you want to know exactly that day in the car?

The pistons that were in that car at the Elgin races were light weight cast iron with a skirt slit, also with a T-slot on top. The horizontal T was located just above the wrist pin groove, just below the lower ring land.

Q. Did it extend part way around the piston? A. Yes.

Mr. Richey: Not so fast. I object to that question as leading. I didn't have a chance to get it in.

The Master: He has already answered. It is leading.

Mr. Bruninga: A slot, a horizontal slot below a ring land—I just want to justify myself—couldn't be anything else but extend part way around the piston or all the way.

The Master: Very well, you may proceed.

(Narrative continued) The verticals of the T were located on each side of the piston, between the wrist pin holes. It was cut all the way through the skirt. It extended all the way down to the bottom of the skirt. There was a vertical offset slot on each side of the piston. As to the offset, if I had a vertical slot, it would naturally, I thought, wear a groove into the cylinder wall; that is why I offset it a trifle. The T-slot was on both sides of the piston.

Q. And those particular pistons were in that car at the Elgin races, in August, 1911?

Mr. Richey: I object to that as leading.

The Master: He may answer. I think he has testified to that.

A. They was.

(Narrative continued) All four of those pistons were slotted in the way I have described. That car was used in the Elgin races. I received some money, in the form of my regular salary from the Staver Carriage Company and a percent that I won, for racing on that day.

Q. I am reading from the Motor Age issue of August 31, 1911, as follows, page 15: "The Staver driven by Monckmeier was brought to a halt at the pit at the end of the fifth lap so that the auxiliary oil tank, which had been broken, could be removed, and water taken in. For the want of oil, the motor had become so hot that when the radiator cap was loosened it shot up into the air and water and steam spouted from the radiator. In four minutes, however, the little car again rushed forth." Do you remember anything about that?

Mr. Richey: I object to that question as leading.

The Master: I think you may have it, he may answer and you may have your exception. The paper would be admissible, or the magazine would be.

Mr. Richey: It is not admissible or evidence of those facts, and it is the reading of the statement

of facts to the witness and he is asked if he remembered them.

Mr. Bruninga: The facts in the publication are not admissible as such except as part of the disclosure.

The Master: I assumed it was to call his attention to some circumstances. Now, ask your question; it may be admitted on that ground.

A. Yes.

(Narrative continued) As to that incident, I blew a tire on the third turn and had to go into the ditch in order to clear the road so cars coming around the turn wouldn't smash into me close to the turn. Then when I got out on the road again, after changing the tire, I proceeded to the pit and one of the mechanics changed my tires and burned his hands and the other tried to put water on there and also, I guess, burned his hands, and by going into the ditch, why, the line coming out of the power feed tank on the side, why, the weeds rubbed that off, or something, the light copper line, and I lost my line, and the motor wasn't getting any more oil and it got so hot that when I got to the pit it just practically blew up. The pistons didn't freeze. They couldn't freeze because I smashed several motors during practice when the piston was the direct cause of burning out my connecting rods, and just simply going through the crank case, and my research from that experience made me split the skirt for the reason that we used to have to cut off about—the regular standard allowance was ground five thousandths but in a racing car we had to cut about 15 to 20, but still that was not enough, there was still a lot of friction created by the piston, and that is why I slit the skirt. I could have about 15 thousandths clearance with my split skirt then.

That car was never taken down since leaving that Elgin race. It was raced in Amarillo, Texas, it was raced in Springfield and Peoria, and then was shipped to San Antonio, Texas, later in the fall, I believe it was November; and the shipping clerk did not take the water out of the cars and the motors was froze up when they got to San Antonio, Texas, and that is the first time we had to dismantle the cylinders and try to patch it up with chewing gum, use anything to try to stop the water. It was raced in San Antonio, Texas, in 1911; I believe it was November. It was raced at Peoria about Septem-

ber; in Springfield also around that time, during the year 1911. I myself raced at Peoria. There was another Staver car in that race. It was called the "Staver-Chicago" car. I believe the name of the driver of that car was "Knueson." You call a man like that your team mate, in these races, if he drives another car of the same make. I believe my team mate in the Springfield races in 1911 was Knueson or Nickren.

Eddie Rickenbacker had an accident in the San Antonio races in 1911; I don't know whether it was 1911 or not, or '13—so many accidents all the time.

I believe I won the Illinois championship at Springfield at that time, and I believe I won some event at Peoria. I don't know whether or not I was first in any event in Peoria in 1911; I believe I was, however. I couldn't say.

Those same split skirt pistons that were used in Elgin, were used in my Staver car in the Springfield and Peoria races in 1911, the pistons that I have described. These same pistons were used in San Antonio in 1911; we couldn't do very much due to the fact the motors had been frozen wide open from the ice and losing all the water.

I don't know what became of those pistons in that 1911 Staver. It was turned back into the stock room, the pistons, the car was fixed up, and one of them was sold, the one I had was sold to Helub Jones, coach to Iowa City, football coach of Iowa City College. Those pistons were turned back to the stock room for the reason you couldn't use racing pistons with that much clearance in a car for pleasure use. At the time those pistons were turned back to the stock room, the men who had charge of the Staver Carriage Company in 1911 were Ellingham, Scott, and another old gentleman, I really don't recall his name. Ellingham's first name is "Herb," I guess. The pistons I have been talking about are the ones out of that No. 27 car.

I did very little racing in 1912. I did some racing in 1913 in St. Louis, Peoria, Springfield, San Anton, that is all.

It was during the State Fair, Illinois State Fair that I raced in Springfield in 1913, and in Peoria during the Implement Show, and in St. Louis a special race meet on a one-mile egg-shaped track. I raced in San Antonio in November, I believe, on a three-quarters mile track. In those races I used a Special Staver, six-cylinder, 4½ x 6 Vanderbilt Cup car, that was built for the Vander-

bilt Cup Race in California, at Santa Monica, in 1914. The motor was built by the Teeter Motor Corporation, Hagerstown, Indiana. That car come equipped with pistons, but I slotted them afterwards by cutting them the way I had done previously, T-slot with an offset in the lower ring. They were cast-iron pistons.

I can produce one of the original pistons, slotted like I said, built by Teeter Motor Company of Hagerstown, Indiana, in 1912. (Witness produces piston.) That piston was in the car that I used, when Teeter Motor Company built this piston, a special light weight cast iron piston that was used in the special racing car. In some races that car had number 8, some races it had number 9, according to what position I drew at the post, what position I was supposed to start at. At that time they changed numbers according to the number of positions you drew out of the hat box.

Mr. Bruninga. The piston produced by the witness is marked for identification as Defendants' Exhibit 3-V.

(Narrative continued) I got that piston, Exhibit 3-V, out of the motor of that special Staver car built for the Vanderbilt Cup race; it was the only car built like it. This particular piston was in the motor before I started in those races in 1913. It was put there by the Teeter Motor Company. The first time I saw it it was in the motor. The piston was not slotted like that the first time I saw it, for the reason that those people didn't believe in any of those saw-fangled ideas. I slotted it like that at Peoria, Illinois, before the Peoria race. I don't know in what shop I slotted it. If I had trouble I always went to the next one I could find, the quicker the better.

That particular piston was used in that Peoria race. That same piston was also used in the Springfield race of that year. It wasn't used in the St. Louis race because I run hot there—I don't know; I don't believe it was slotted there. It was slotted in the San Antonio race of 1913.

I also raced in 1914 with the Staver No. 9, the same car I had raced in 1913, except a No. 9 on there which was placed on there in San Antonio, Texas. I drew No. 9, I believe, down there, and that number always stayed on the car thereafter.

I received some money for the 1913 races. I got some money in San Anton, got some in Springfield, got some in Peoria, practically every place I went. I only got half

of that money, the Staver Carriage Company got the rest.

I didn't race in any towns except the above stated ones in 1914, for the reason that the Staver Company wasn't doing any racing. The stockholders voted against racing in 1912. We did a little racing in 1913, and it was charged I believe to advertising or something.

The particular car that I used in the 1913 races I also used in 1914. The Staver Company owned part of that car in 1914. I bought it on the payment plan, in the early spring, around April of the year following the 1913 races.

I didn't race in any big city during 1914 because I wasn't driving professionally for them any more; I was free-lancing, for the reason I couldn't afford to finance myself on big national events.

In 1914 I raced in Streator, Illinois, Carfield, Illinois, Peoria, Illinois, Kewanee, Illinois, LaSalle, Illinois, Leroy, Illinois, and Mattoon, Illinois, Iowa City, Iowa, Tipton, Iowa, Williamsburg, Iowa, Florjind, Iowa, Maryville, Missouri, Bethel, Missouri, Auburn, Nebraska, Nebraska City, Springfield, Missouri, Tulsa, Oklahoma, and that is all.

I have one of the pistons here that were used in that car up until September 1914. I mean piston, Exhibit 3-V. The new piston was used after September. That was an aluminum piston.

I believe a number of mechanics saw that original piston that I made in 1911 prior to the Elgin races. I believe the ones who saw it were Ray Latham, Knueson, Herb Ellingham, and a brother of his.

I had help in slotting those pistons before the Elgin races; I used to have a good many flunkies helping me, that would help me do this and that; I believe one of the Ellingham boys was one of them. I always put the piston in myself, excepting always had somebody help me let the cylinder block down.

Emery T. Knueson, my team mate, saw those pistons in 1913 like Exhibit 3-V. I don't remember any other in 1913, unless some of the boys, some—yes, when the car got back to the factory for a little overhauling, I don't know.

I said the pistons 3-V were used in that Staver car No. 9 until September, 1914, and I put another piston in. It was another special make, that was an aluminum piston with a special head. I don't know who made that piston. I don't know whether I had it made in Chicago or

Cedar Rapids. I had the pattern made and had the piston cast, and I had it machined; I don't know whether it was Chicago or Cedar Rapids; I couldn't tell you; I have been trying to find out; I can't tell you.

That car had six cylinders. I used those aluminum pistons in all cylinders. I have one of those pistons. (Witness produces one.)

Mr. Bruninga: Piston produced by the witness is marked for identification as Defendants' Exhibit 3-W.

(Narrative continued) I slotted that piston, Exhibit 3-W, before it was used. It was afterwards used as slotted.

One of sides of that piston is broken away, and it had a slot on that broken side just like on the other side, and that piston wouldn't have the other slot there. I had a fire, warehouse burned up in Tipton, Iowa, where I kept all my relics, junk, and so forth, and the patterns burned up and the pistons, and I just got two or three of those pistons left. I have one or two more of them. I don't know where they are—yes, I believe I can find them. I have searched for them. I have another one but I haven't the rest of them. I didn't tell you that I had another one, and I didn't even know I had this cast iron one, I didn't know I had it, I never seen that piston since the fall, September, 1914.

When I put these aluminum pistons like 3-W in my car, I took the cast iron pistons like 3-V out. Now I know, because this was one of my spare pistons that I would change. That is how I happen to have this one, but I didn't know it still existed until that time when I was hunting for pistons a couple of months ago. This 3-V was one of my spare pistons, the cast iron one, that is why I happen to have it.

I didn't find that piston, you (indicating Mr. Bruninga) found it. We was down there looking for the aluminum pistons and I run around and I could only find that one and you looked under the junk box where my trunk was standing on, and you grabbed a piston out of there, out of the corner. That is the first time I have seen it since 1914. I didn't know it even existed, it was just like a shot out of the sky, like a piston that dropped right out of the sky into your hands. I saw you pick it up, it was my piston. I didn't know it was still existing. That was in my garage in Tipton, Iowa, in which I keep a lot of experimental stuff, bench and a lot of relics. That

garage is locked and boarded up. I took you over there and we found that piston.

This aluminum piston, 3-W, I made in 1914. I used them in 1914.

Q. In any races in 1914? A. Yes, that piston—am I supposed to tell you whether it was used or not?

Q. Yes, I am asking you whether it was used in any races? A. Yes, it was used in Iowa City, it was used in Williamsburg, it was used in Tipton, it was used in Florenda, it was used in Maryville, Randolph, Nebraska City, Neb., Auburn, Neb., Tulsa, Okla., Clinton, Iowa, Beckwith, Mo., and Maryville, Mo.

(Narrative continued) I won practically all of those races. They were all small towns, non-sanctioned race stuff. I wasn't driving professional any more, unsanctioned.

None of those pistons in 1914 scored on me, or were worn so bad they would go to pieces.

I wintered in Davenport, Iowa, for about three months in 1914 and 1915, and then went to Tipton, Iowa, where I knew a gentleman that wanted to ride with me in the car in 1915. Tipton is 38 miles from Davenport. I have a home in Tipton, but I live in Davenport now. The man who wanted to ride with me was Mr. Everett Shipley, who is now dead.

A number of people in Tipton saw those pistons, especially one boy who worked, or roustabout in the garage where I kept my car, and did some repair work on my car, by the name of Jack Henderson. Henderson actually saw those pistons like Exhibit 3-W. I know he seen it, because he mentioned I had a cracked piston in there, my pistons were cracked. I explained to him they wasn't cracked, because I wouldn't have explained it at all if he wasn't just a boy trying to learn the business; that is why I explained it to him.

Mr. Richey: I object to his answer, states his conclusion that he must have done it.

(Narrative continued) I raced in 1915. I raced in Anamosa, Iowa, in 1915, in the early part of the year. I raced, in addition to Anamosa, in Iowa City, Marion, Williamsburg, and Tipton, Iowa. I won some of those races. I received some money for winning those races in 1914 using the aluminum pistons like 3-W.

I used aluminum pistons in the 1915 races.

I didn't intend to race in 1916 but I did. I used the same Special No. 9 six-cylinder Staver car that I used in

1915. I had the same pistons in that car in 1916. That car was sold in 1916 to a man by the name of Gallmeier. I started to make delivery. He gave me, it was sold for \$850, and he gave me \$200 down and the balance was supposed to be in bankable notes when he got delivery of the car, and I proceeded to fix the car all up for him and I was also supposed to show him how to race with it, and in the meantime, before I had the car finished, he hung himself.

The paper marked Deferdants' Exhibit 3-X, dated June 20, 1916, which you have just handed me was my original agreement that I wrote up and he signed it. That is Mr. Gallmeier's signature, and his widow still lives right in Clinton, Iowa.

That picture on Exhibit 3-X was a photograph taken in Iowa City with several cars, and I simply cut the other ones out and had a cut made of it and used it for advertising, used it on postcards and sold them for ten cents apiece. The gentleman in the lower left-hand corner is myself as I appeared at that time. No, this picture is not at that time; it was taken from off of another photograph that appeared in the Chicago Tribune when I won the trip around Lake Michigan in 1915, simply cut that out and made a cut of it. This picture is a picture of the Iowa City race of 1914.

Mr. Bruninga: I offer in evidence Exhibit 3-X.

(Narrative continued) This Mr. Gallmeier didn't get the car. When I overhauled the car I put new—tightened up the bearings, relined the main shaft, and perhaps put in some new wrist pins and made him some new piston rings—whatever was needed. I left the piston Exhibit 3-W in the car. I only had two original pistons and I never bought any more pistons and these are the last pistons I had made.

I simply started racing myself that year, that summer and fall again, and I wound up with it in October or November, I don't know which. When I got through racing I came back to Tipton, I started to run a shop back of Carroll Garage and started a repair shop, and had several men working for me, three men working for me, and the next spring, why business was so rushing I had four men, and was too busy to race again. I didn't bother with racing no more, and the war began and some of the men went over to France and I simply didn't race, there wasn't any more racing. The car was in Tipton. I don't know where it is now—I believe it was sold when I

sold it again; it was sold, and I sold it to a man, a Mr. Sindt for a Ford car and a \$200 note, on which I had to sue in 1929.

I didn't leave the pistons like 3-W in the car; they were taken out, for the reason that Sindt, I was going to help him fix up the car and the motor was all torn apart and I was supposed to give him all assistance in timing the car and putting it back in A-1 condition. I advised him to have the cylinders reground and new pistons, which were naturally needed when it was reground, and that is how I kept the pistons, and I especially kept the magneto. I still have that magneto. I didn't keep the pistons for any particular reason, just simply a couple of them, about three of them I kept, not intentionally, for no reason whatever, just accidentally, that was how.

I said the piston 3-W went through a fire. That was in Tipton, Iowa. I had a small warehouse alongside of the factory there, that was struck by lightning one night. I had baking enamel, or dipping enamel, and some lacquer, and it caught fire and I lost my patterns, a good many patterns I lost in the fire, plus those pistons was in that warehouse and went through the fire.

I have not made any other pistons like Exhibit 3-W since September, 1914. I made only one set of them. I believe I designed a set of pistons for a man by the name of Jordan, for a National racing car, that was in the fall of 1914 or 1915, I couldn't say, but I never built any more myself for this particular car.

With reference to the cast iron piston, Exhibit 3-V, I never made any more slotted cast iron pistons after I made the set of which this is one, for the reason they were too heavy. I wanted more speed.

The T-slot in the piston used in the Elgin races was originally put in there for the reason I busted some of the motors in practice, which was due directly upon the friction, upon the high speed that the piston created in conjunction with the cylinder walls, and made such tremendous pulling and pushing pressure upon the bearing that I simply burned the bearing out, had to work too hard.

When, as you said you showed this piston, or other people saw it, did you tell them anything about it, or don't you remember? - A. I never told my—I always kept those things away from my team mate. I wouldn't keep them away from my mechanic who was working for me, excepting I wouldn't let the outside drivers for the State of Iowa team with me; I was just a starter as a

professional, I just won them, I didn't let them know it, no.

(Narrative continued) I didn't hide it from Ellington, the mechanic, because the car was brought to the factory several times and I wasn't there, either on tour driving or some other publicity stunt. I didn't try to hide it from Knueson, after he found out. I didn't try to hide it from Henderson, that was in Iowa, then. I didn't hide it, neither did I advertise it. I made money by using those pistons in the car in the races. I don't know whether or not you can attribute that to the pistons, Exhibits 3-V and 3-W or not, the only thing I know I always had a faster car than my team mate, which were identically alike except for the piston.

You got in touch with me through a man by the name of Packer, who was at one time connected, when he first graduated from college, he was connected with the Staver Carriage Company in Chicago in 1911 or 1912, somewhere around there, and he is now editor for the Motor Service, publishing a magazine in Chicago, and he in turn told Mr. Hunter, who is the manager of that publication, and I believe I mentioned something to him about this last summer, we was talking about old times. I said to Packer, "Yes, do you remember those old pistons I made?" And he said, "Yes." I said, "I wish I had gotten them patented." Hunter talked up on the pistons, he said, "Do you know anything about split skirt pistons?" And I said, "Yes, a little bit." That is all that was said about it, and the first thing I got a letter from Mr. Hunter, who is the manager of the Motor Service magazine, and that is how it came about. And the next thing that happened, you (indicating Mr. Bruninga) appeared on the scene.

I don't know anything about this case. I don't even know who the defendants are.

I don't know anybody of the Ray-Day Company that makes Ray-Day pistons. I do not know anybody connected with the Sterling Products Company of St. Louis, excepting that I had a letter from you, or them, I don't know—Sterling Products.

I wish I had a financial interest in this case.

Q. Of course I have promised to pay your expenses, haven't I? A. Yes. Did you?

Q. I admit I did. A. Well, all right.

(Narrative continued) You sent me some money for coming to Cleveland. Nobody asked to subpoena me. I don't know if you asked me as a favor to come here. You never asked me as a favor. You asked me if I would go down or do something, I don't know—go down to Cleveland, yes.

(Short recess taken.)

CROSS EXAMINATION by Mr. Richey.

Mr. Richey: I want to renew my objection to all the testimony on the ground it has not been set up in the answer.

The Master: Same ruling.

I never gave Mr. Bruninga those pistons. He came to see me in Davenport, Iowa in September, I believe, or August 1932; I really don't know.

Q. And when was it that the editor of the paper, Packer, get in touch with you about this matter? A. I went to Chicago—Packer wrote me a letter, a four-page letter, telling me a lot of the things that used to happen about 20 years ago, and was kidding me for the reason that he seen one of my advertisements in the paper, or he seen my name written under a letter that was sent to the Motor Service Publishing Company, and then he wrote me a letter. That is how he happened to know I was in Iowa. So the following time I went to Chicago I stopped in there and we had a little old time reunion, and when I met Mr. Hunter we got talking about different things.

Q. Pardon me for interrupting, I just asked you when that was? A. July or August, 1932.

(Narrative continued) The Staver Company that I mentioned manufactured automobiles and carriages. They manufactured automobiles since 1909 to 1914, first part of 1914 they quit. They were a well-organized company, and had records and all that kind of thing that those well-organized companies do. I was not hired by them to race a car. I was hired by them to take charge—I started to work at the Staver Carriage Company, in December, 1909. Mr. Holt, who formerly was at the Teeter Motor Company, got to be manager of the Staver Carriage Company, motor building division, and he wanted me to take, to go up there and take charge of the testing department of the new cars, which I did, and that is all I

did until the Elgin races. In fact, the Hawthorne dirt track, that was my first dirt track race, in July of 1910, and the Elgin races, and then I also drove in the Elgin races, plus two expert professional drivers they hired, because I was not an expert racing driver at that time, that was just my second race. Then I drove that fall in making the five state tour, together with another driver, or whatever they called it. Then the following year we built cars for publicity purposes and racing, which cars the Staver Company, I believe, voted \$42,000 for racing expenses, on experimenting and developments, and which I mostly got my experience out of. That is all the Staver built these cars for, racing purposes. I became quite skilled in racing. I don't know how long it took to become skilled in racing after I started it; you learn something every day. Racing is a kind of special use of automobiles, and requires a special kind of skill in driving. Special kind of cars are used in racing today, but not at that time. You was permitted to have only such things on the car as the stock car specification called for, unless it was a free-for-all race. Therefore we built 25 motors exactly alike, with a special cam shaft, with special light-weight pistons, and bodies, but the cylinders and everything else was absolutely stock. The cars were built especially for racing, though.

I said that I allowed these pistons, like Exhibit 3-V, fifteen thousandths clearance, twelve to fifteen, before I split them, and a little less after I split them. I realized that less clearance because it wouldn't slap so much and I was able to get more power by a little less clearance, and let the skirt expand.

Q. My question is, you say you had these pistons in the car with fifteen thousandths clearance before you split them? A. Yes.

Q. Then after you split them you fitted them with less clearance? A. With the same clearance, only they were split.

(Narrative continued) I believe I allowed twenty thousandths clearance when I got these aluminum pistons; I couldn't tell you exactly any more. That was after I split them. It was a special design piston. Another one of my ideas, a concave top, I thought to get the blow more to the center. I had these built special, everything turned up and I split them. I had the same clearance before I split them as I did afterwards. I had these

aluminum pistons in a six cylinder car. I had seven aluminum pistons, one extra one in case of damage to one of them, or something like that.

Quietness is not sought for in these racing cars; piston slap is no matter of consideration.

I didn't find this iron piston, Exhibit 3-V; it was found in my relic box that I had in Tipton, Iowa, in the garage. Besides these pistons, I have in that box some steel, some spring wire, automatic bolts—just a junk box, that is all, things I will never probably use again. I didn't even know I put this piston Exhibit 3-V there. I didn't know it even existed. I knew at one time it existed, you see, but I had changed pistons, junked pistons, and I even didn't know I had one left until Mr. Brunging rummaged around and he found it,—well, it was—I actually felt foolish. I hadn't forgotten it was there—I never put it there; otherwise I would have known it. Maybe my wife put it there, found it in the house someplace and put it in the garage in the junk box; maybe one of the boys working for me in the factory put it there. That piston had not been in that box for 15 or 20 years, because that box was only built, that box was—let's see—in 1917 or 1918, something like that. It had been in the box since 1917 or 1918, about that. This piston was flying around some other corner. I got a big room upstairs where I keep a lot of records, patent matters, piston inserters. I formerly made piston ring inserters down there.

In running these races sometimes you try to keep everything about these cars in prime condition, and sometimes you don't. I don't like to race a car with a defective piece of apparatus in it if I can help it, if I can help myself. You wouldn't drive with a defective spindle on a car or a cheap piece of steel in your axle shaft. If you have a defective piece of mechanism, it is liable to break and throw you out of the race, if not injure you; I got stopped a lot of times by not even defectiveness, merely neglecting the gaskets from the carburetor, or generator wires, or a lot of things happen. I usually inspect my machinery pretty well before I race, but always something new happens, sometimes. You look over things carefully so you won't be delayed or hurt by some defect, before you go into these races, but you get careless at it.

This piston, Exhibit 3-V, was never put in any other car except this racing car.

Referring to the aluminum piston, Exhibit 3-W, I had that, I have got another one or two. It was in the garage. It was burned in the fire in 1922 or 1921. It was in the warehouse with some patterns and a whole set of pistons. The rest of them were junked, but I kept three of them. The rest were burned beyond recognition. They were aluminum.

Q. What do you mean by "beyond recognition"? A. What is the use of keeping a piece of junk that is all burned up? I have too much junk now.

Those aluminum pistons were in the warehouse, prior to the time they were burned up, among some patterns of different description, and it was burned up, that is all; lightning struck it. In the warehouse the dipping was done, dipping piston inserters. I made an automatic piston inserter that had springs all around it, you could just shoot the piston right through, automatically compress the rings. You can still buy them on the market today.

Q. What was the purpose of the automatic spring piston? A. Can I show you? These rings here are hard things to put in, especially in the old Model T Ford, because the mechanic tries to put them in this way, puts a clip around, and the piston is a little tight, and the sharp edges project, and he finally snaps this one in, and the final one, he snaps his finger on it, and otherwise, and with a piston inserter you can stick this piston in, automatically push it right through, it closes the rings up and shoots it in without injury to your hands.

If you don't use piston rings you can't drive, the pistons without rings, you have to have piston rings to have the pressure; but they have been used without rings.

Q. Did you get that up to take care of expansion, prevent scoring, things like that? A. Yes—not the piston inserters; that was a tool to put the pistons in the cylinders with. That was a tool, that automatically compresses the rings on the piston so you can get rid of that trouble.

(Narrative continued) These pistons like Exhibit 3-W were put into the warehouse in 1919 when we moved from one place to another, when that warehouse was used for dipping piston inserters.

It is accidental that on one side of Exhibit 3-V the slot was not cut through at the top; it wasn't cut through; it is supposed to be cut through, yes, I notice that, but

that is all right. It is supposed to be cut through on both sides. On the other side it is broken away at the top, perhaps, because the milling cutter was so big it would cut into here and it was broken. To make the slots in Exhibit 3-W, I drilled and sawed them out, because there was no milling machine handy. I first drilled a series of holes and then sawed it right through there. All of the slots in these pistons were just like those shown in these two I have produced here. That is, a trifle offset, which I thought would eliminate cutting a groove in the cylinder wall.

Q. You made them all the same way. That is, the iron ones you cut in with a milling tool and the other ones you bored out and sawed? A. I couldn't help myself otherwise.

(Narrative continued) Of all the races I won, I won't say that I won them due to my skill as a driver, otherwise they wouldn't have hired other professional drivers to team with me. During the years I won a lot of those races. I don't know whether or not I won a great many of those races due to my own skill. I don't think I used extraordinary skill. I never had very many accidents. I tried to be as careful as I could.

I ran a good many races in 1910 without having pistons that were split. I won some of them. Let me see, I raced—three or four. I ran perhaps six races my first year. I won two-thirds of them to begin with. I won a higher average than that later. I said I won three or four—I don't know whether three or four out of six. I could name exactly where I raced. I raced in Hawthorne, I raced in Elgin, I raced in Minneapolis, I raced in Peoria, and I raced in Springfield. Well, I guess I won about three or four out of six or seven.

Every race we had one or two or three events. You see, I might run in two events in the same day or three events, or I might only run in one event. There are class races; and they had events for the 161, and the 230 class in 1911 was a little larger motor. Our stock motor was $4\frac{1}{2} \times 5$, and the stock motor was put in a different car that would bring us into the class of 301 to 450, so we took the pistons and we built special, 25 special motors of $4\frac{3}{8} \times 5$, which brought us into the 300.7 piston displacement, which was just a few notches under the 301, which brought us into the lower class.

I ran, maybe, 20 races in 1911. I won perhaps ten or eleven of those, I don't know, I couldn't say.

In 1912 we didn't do much racing for the reason that the stockholders for the Staver Carriage Company wouldn't stand for my racing cost, the racing cost was forty or forty-two thousand dollars in 1911, so they cut it out for that reason. I did a little racing, which was charged to publicity, especially that trip around Lake Michigan, which was I believe a fourteen or fifteen hundred mile tour, of 25 or 30 starters, and I won that, and that was the main one.

I didn't run very many races in 1912; a couple of them; two or three of them. I didn't win any of those, because I was just—I drove an Elkhart, and they didn't know it was me driving because it was a non-sanctioned meeting, and I won that one. I drove without their knowing who it was, because I would have been barred by the Three A's, American Automobile Association. They would have barred me because it was a non-sanctioned meeting, small country class, they want to have a race meet, and no one wants to pay \$100 or \$200 for an official to come down from New York to start the flag to start them off, and they run their own races and call them non-sanctioned.

I ran perhaps twenty or thirty races in 1913—maybe 13, 14, 15 or 16—I don't know; a good many. I won about half of them.

Q. In 1914 how many did you run? A. Pardon me; did I hear you say you wanted to know how many races I ran in 1913?

Q. Yes; how many you drove and how many you won? A. I didn't drive very many races in 1913; probably eight races.

Q. Now, a while ago you said twenty, now you say eight. A. Pardon me; I thought it was 1914, you see.

(Narrative continued) When I said I drove twenty races in 1913 and won ten of them, I meant 1914.

I drove seven or eight in 1913; in four different cities, I believe, and different events; maybe I run in two events of the class. I probably won about half of them.

I don't remember how many I ran in 1915; 20, 30, or 40. That has been a long while ago. I can name you the towns all right, but I can't name you exactly how many events I drove all told. I could figure it out for you.

I thought I was going to quit racing in the fall of 1915, but I didn't. I raced in 1916; I probably ran in

15 races in 1916. I don't know how many of those I won; about half of them. I couldn't say. It wasn't nothing like winning all the time; and I couldn't take everything, because I always had one tall fight on my hands at all times; the boys were trying to bar me from the track, because I had too fast a car for them; and they had districts they barred me in a number of races. They weren't professional drivers any more than I was. They claimed I had too fast a car for them.

Mr. Richey: I object to what he says they claimed.

The Witness: Well, they disbarred me because of that.

(Narrative continued) The Staver Company assembled these racing cars. They only built four racing cars in 1911, three permanent and one spare. But we had 25 motors of the caliber, with the same size cam shaft, pistons, and everything, all 4- $\frac{3}{8}$ " size, in order so that we could call that car a stock car.

They built other cars besides racing cars. They built pleasure cars. In 1911 I believe they turned out, highest production, three or four a day. That was increased in 1912 but I couldn't tell you exactly. They didn't go out of business; they simply quit for the reason that we had also a little depression in '13, and Harry Staver, President of the concern, wanted to divorce the automobile department away from the carriage department so he could have larger capacity, more workmen, and he went to New York and couldn't raise the amount of money so he could separate the two properties; so he just quit.

The Staver Company didn't make any racing cars in 1911, in addition to those four, excepting the one that I built up myself from stock, and a few things special; I just drove it for publicity, for the dealers.

The Staver Company never put pistons like Exhibits 3-W or 3-V in any of their cars, either racing or pleasure cars. They used the iron trunk type piston. The Teeter Motor Company that built them, I always had to take them down, and we assembled them ourselves and we polished the walls with white lead and various tricks that we thought, that I thought might give me more speed, that is all I was interested in, more speed. I didn't go down to the Teeter Motor Manufacturing Company and help them to fit the pistons in the racing cars,

they shipped the motor to Chicago and we worked on it at the shop.

They also bought their pleasure car motors from the Teeter Company. I was sent down there in 1910 to look over their motors, and they sold me on their motor, and we changed from the British-American and the Continental motor to the Teeter motor, which put the Teeter people on the map, and after that perhaps a dozen firms used the Teeter motor, started using them in 1913 or 1914. That is, the Staver Company sent me down there to check over their motors, see how they worked, and through my recommendation they shifted to the Teeter motor.

The clearance in the pleasure cars, between the pistons and the cylinders, was, oh, six thousandths, four to six thousandths. Some of them were tapered. It was all in an experimental stage which was the proper clearance, sometimes gave a taper clearance of four to six, three to six, sometimes five or six straight down; more or less experimental; there was no standard.

I did not recommend to the Staver Company that they use this kind of split I had in the cast iron piston; nor did I recommend it to the Teeter Company.

Q. And you did not recommend the aluminum piston like 3-W with the slit in it, to either one of them, did you? A. The company was not building automobiles then any more. I did get a bawling out from Harry Staver at one time, yes.

Q. What did he bawl you out for? A. Not exactly bawling out, but anyway, or somebody told him I had ^a was certainly getting off my noddle or something, using pistons like that, and he wanted to know why.

Q. So the Staver Company, you claim, didn't know about it? A. Well, some of the boys, I suppose some of the boys didn't like me very much, or something like that; anyway they thought they better tell something on me, what I was doing, probably ruin my reputation.

(Narrative continued) The Staver Company and the Teeter Company, of course, were looking for improvements; they were working along, experimenting, trying to develop their equipment.

I was paid my salary and expenses in these races while I was with the Staver Company. I was working on a salary and expenses.

The name of one of the flunkies I had working for me was "Ray Latham." I don't know where he is now; I didn't try to find out.

Herbert Ellingham is in Chicago. I know where he is but I don't know his address; I can find it though. I don't know his brother's name. I called one of them Herb and I called the other one "Red," his nickname. I guess he lives in Chicago; I guess they both live in Chicago. You probably could locate them there by looking in the telephone directory; I don't know.

The name of the fourth man who knew about these pistons is E. T. Knuesen. He is now in Washington, D. C. I can send his address to you.

There is another fellow by the name of D'Vorsky that knows about these pistons. His initials are "R. W." He is located at Shreveport, Illinois. He was in Rockport, then Shreveport. I believe he is in Chicago now. I know his address in Chicago, but I couldn't tell you offhand.

Jack Henderson, whom I mentioned, is in Wheatland, Iowa.

These holes were bored in these pistons, Exhibits 3-V and 3-W, to lighten them; also you will notice they have a very thin skirt on there, a very thin, thinner than the stock car piston. It was cast that way, special cast all the way around; made special piston patterns for that casting for that car. That was specially built for the Vanderbilt Cup Race in 1914, run in Santa Monica.

I have an automobile repair shop, started in the fall of 1916. I have to replace pistons in cars in repairing them. I have not put any of the standard types of aluminum pistons in any of the cars that I have repaired. I never had any split skirt pistons that I put in any of the cars I have repaired. I have had cars that had piston trouble; I have seen aluminum pistons with the head broke out of them, ring grooves worn—yes, that's about all. I have had cars in with iron pistons that had piston troubles, too. If we had trouble with iron pistons—one thing, they were too heavy, and another thing, they were worn and plattered, and I used to take them and expand them.

In the repair work I have done since I have quit racing, I have had trouble with iron pistons I have had to repair; it wasn't trouble; they were worn out, that is all; had to expand them and put them back in again, and make a better piston out of them.

I have seen aluminum trunk type pistons scored. I have seen them have trouble, that is, scored and melt in the cylinder wall. When I found such pistons I re-

moved them, threw them out and put in some other pistons. I believe I substituted cast iron and aluminum pistons for those; used any standard piston at that time, for all cars. I was only in the repair business for a couple of years. I never did like to replace pistons, because I always expanded the old pistons that were in the car.

I said I had seven of these aluminum pistons. I used all seven of them.

Q. What was the occasion for using the extra one?

A. Do you see this ring here? (Indicating on aluminum piston.)

Q. Yes. A. These grooves got worn, had widened them out. Probably started out with a 3-16" groove, and kept on widening it out. You see this gets worn. That is all I needed, was piston rings.

(Narrative continued) All of those pistons got worn there in the grooves. It would probably take a season's racing, or a half-season's racing for them to wear that way in the grooves; under high speed they wear very rapidly. I had only one extra piston, and I used that extra piston.

I ran that car with these aluminum pistons in it from September '14 to '16. The only thing I had to replace was the rings, and I believe I replaced wrist pin walls. I said I had seven pistons like Exhibit 3-V, for a six-cylinder car. They wore out in about the same way that I said the aluminum did. You can see where this groove was widened out several times. They would last longer than the aluminum. They clattered a little and you would have to use a lot of oil. They clattered when you started; have to use heavier oil. In starting up these pistons, Exhibits 3-V and 3-W, would clatter a little bit and you would have to have a little oil in there.

I used this particular Exhibit 3-V piston. The reason I substituted a piston like Exhibit 3-V for one of the others, was, perhaps, the rings were bad, or you would break a ring on there; you can't get exactly the same size rings wherever you are, the smaller cities; you would have to keep special made rings; you couldn't buy them always; had to have special rings along; and all I had to do was to take a piston and change a piston ring.

Mr. Richey: That is all.

Mr. Bruninga: No re-direct.

(Adjournment taken to following day at 9:30 A.M.)

(At 1:30 P.M., Friday, January 27, 1933, the hearing was resumed).

Thereupon, HERBERT FRANK ELLINGHAM, a witness called by Defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Brunninga.

My name is Herbert Frank Ellingham. I live at 3938 West 61st Place, Chicago, Illinois. My business is automobile repairing at the present time. I came to Chicago in the spring of 1911. I started to work right away after I came to Chicago. I came right from Racine, Wis., and started right in to work at the Staver Carriage Company, that was in the automobile department. The Staver Carriage Company made a car in 1911 known as the Staver car. Up until 1914 that company was called Staver Carriage Company, automobile department. Then in 1914 they reorganized and called it the Staver Motor Car Company. I was with the company at that time. I stayed with the Staver Company until November, 1930.

I attended automobile races around Chicago. The first one that I attended was in Elgin, Illinois, in 1911. That was rated as the biggest race of automobiles in them days. I remember one of our drivers, Mr. Ireland, got killed there, before the race, at practice time. By "one of our drivers" I mean one of the Staver team. We had three teams, three cars. Both raced at that time. The drivers were Ireland, Gus Monckmeier and another man there that they hired just for this race. We had two of them; I can't remember, can't recall his name—Luther, or something like that; he was just there to drive that one race, that was about all.

Mr. Monckmeier's full name was Gus. That is all I ever called him. He was an all-around driver, usually the final tester; in other words, he done all the experimental work around there, testing cars, and he also drove in races. He drove a Staver car in the Elgin race in 1911.

My job at Staver's at that time was, I had charge of the stock room, getting out all the parts. It was an assembled car. I had to furnish all the parts, from rear axle, whole complete car, build it up, furnish all the parts, put them out on the floor so the mechanics could rebuild the parts and make cars with them.

I was born in 1894. I was about 17 or 18 years old then.

That Staver car that Gus Monckmeier drove had a Teeter motor. I saw that car myself. I was at the races and saw the races. I saw Gus Monckmeier drive in that race. The bore of the cylinders in the car that Gus Monckmeier drove in that race was $4\frac{1}{2} \times 5$, they called it. 5 was the stroke. It had four cylinders. Just cast iron pistons were used in that car that Gus Monckmeier drove in that race. I saw the pistons; I helped put up his car. He came in there one day and he wanted somebody to help. So I helped him, tore down the lower case, I remember that because I got all full of oil and grease. He said he had to have it running right away and he asked for help, wanted me to work there that evening, so I worked on it and helped him put up the pistons and the rest of it.

The pistons that were put into that car before the race were the common ordinary cast iron, stock piston, which he sawed with a hack saw, and slotted a sort of T-slot below the piston ring, and kind of a jog, too, on the side of the piston. I remember when he was doing that I said he was crazy, the pistons would never hold up. I thought they would fall apart. He said, "No, I know what I am doing. Somebody help me with what I am doing so I can get it together."

The slot was from the lower side of the ring, and slotted up on the side of the piston, and then drilled a hole so he could get the hack saw up, with the jog up to that slot. That was known as a trunk piston, cast iron piston with a head and skirt and wrist pin bosses projecting inwardly.

The slot that had an offset and extended on one face of the piston downward, was just opposite the wrist pin. The wrist pin comes here and the slot on the other side, just the opposite. I mean right between the wrist pin bosses. I would say that slot was on both sides. I remember when he was putting it in, I said, "Gus, what are you putting these in these pistons for?" I said, "These will never hold up." He was one of these funny, farmer boys, and he said, "I knew what I am doing. All you have to do is help me get it together."

The reason he gave for putting a T-slot in there was that it would take the place of the expansion and contraction of the piston, and it wouldn't stick. He burned up two motors before that from the pistons freezing in the cylinders and breaking the two motors. I know he had trouble with two motors before that. He said to me, he

said, "Don't worry. I know what I am doing." He said, "This is going to take care of my trouble." He wouldn't talk much; he was a kind of a funny fellow. I said I would help him put those pistons into the car. That was before the Elgin race. I worked on them that afternoon and evening with him. He used that car in that race and I saw him race.

That Staver car had a pump oil system. The lubrication of the crankcase was the splash system.

I saw those pistons after the race. We didn't tear these cars down until he made two or three other races. I know he went to Springfield, and the last race was down in Texas, and they shipped them back then and we tore the motors apart and took the parts and put them in the stock room. We still had parts up to a couple of years ago, the ring gears and pinions and cam shafts. We only had special cam shafts and pistons in them, otherwise they were a stock car.

I saw those pistons after the cars came back. None of them were broken. We took the pistons out of the car, to build another. In Riverview Park we had a motor-drome, and we assembled one of these cars with standard stock parts and turned it on that track, just for a show. It was a bowl like a ninety degree bowl, about the size of this room, built on the track. We took those pistons out of there and took the ring gears out of there and cam shaft and built common stock cars so as to advertise the Staver name. After those particular pistons were taken out of his car, they laid in the stock room for quite a while. I can't say what was done with them; might have junked them. I was in the stock room at that time and until 1916.

The Staver Motor Company continued in existence and I continued working for that company. They kept on building cars up to 1914. The car that was built in 1912 was also a four-cylinder car. In 1913 and 1914 we built fours and they called them the 45 and 55, and then some 65; 55 was the six-cylinder car and 45 was a four.

I remember the 1913 racing car. We shortened the frame on a four-cylinder car, shortened it up so it would be shorter, then put a six-cylinder motor in it. We always called it the "Betsy," and didn't have a number on it, as I recall it. We always called it that. They finally sold it to Mr. Gus Monckmeier about 1914. The bore and stroke of that car was $4\frac{1}{2}$ " diameter by 5" stroke. That was also a Teeter six motor.

With reference to the pistons that Mr. Monckmeier made or slotted before the Elgin race, I am pretty sure there were five pistons slotted for that four-cylinder car—four in the car and one extra.

Q. Did that piston have ring grooves on it for piston rings? A. Which one?

Q. That one, the pistons that were slotted, did those have ring grooves in them like ordinary trunk pistons? A. I don't think so, not in 1911.

Q. Did it have piston rings on it? A. It had piston rings on it.

Q. What did those piston rings mount in? A. Oh, a ring groove, yes, sir.

(Narrative continued) That is the only time I saw Monckmeier slit any pistons, before the Elgin race. That is the only time I know of. Those were cast iron pistons.

As to the business of the Staver Company after the assembly of cars was discontinued—we called it the Staver Motor Car Company, and we done general repairs, and sold parts for all the cars we had out, and repaired all the Staver cars. We had about 1200 cars out and we figured they had to have cars repaired, so we just took over the service station.

Referring to Defendants' Exhibit 3-V piston, that particular piston is like we had in the six. I know that I remember this grooved-out part—that was special. The piston we had in the six-cylinder Staver car having the Teeter motor was just about on this order right here, in 1911. It wasn't in the Staver six in 1911. This is a six-cylinder piston right here. This was in the Betsy model; this is 1913. But the 1911 was on this order, only a smaller piston. That piston is exactly, you might say, like the piston in the Betsy. That is a regular Teeter piston for the six-cylinder car in 1913.

Q. Look at those slots in that particular piston, Exhibit 3-V, and compare those slots with the ones that you said Mr. Monckmeier put in the pistons that he used in the Elgin race in 1911? A. I would say it was exactly the same. It was on the same order as this exactly, because when he was sawing this here I told him the thing wouldn't hold up.

Q. When you said "this here" you mean the vertical slot that goes through the hole? A. Yes, sir.

(Narrative continued) I said the slot was offset, it is a little here. I remember this wasn't straight, it was

just like this. You see this comes up here and then over this way a little bit, instead of coming right straight up. That is the reason we drilled a hole in here, so we could get the hack saw in here. Those holes were drilled in there; that was extra. They were drilled in there to lighten up the piston, take so much weight off of it.

I saw Gus Monckmeier last about five months ago. He didn't say nothing about the pistons. He said, "Anybody comes to you and talks to you about it, just don't tell them nothing." I knew at that time what particular piston he had in mind, because about seven or eight years ago, maybe more, I know he wanted to know if I would sign an affidavit for someone on the same piston. I think it was seven or eight years ago, some case was supposed to come up in New York or something. He wanted to know if I would sign it, and I said, sure, I would sign an affidavit because I knew just exactly what it was.

He didn't tell me what to testify to; he just asked me if I remembered the pistons, and I described it to him as near as I could; that is all.

I first met you (indicating Mr. Bruninga) about a month ago, I would say. You asked me about this piston, to tell you what I knew about it, and I did. I didn't tell you a different story than I have told you now.

It has been a good many years since I have seen a piston like Exhibit 3-V with the slots in it. I haven't seen—I think we had one extra piston, or one extra piston laying around the stock room like this one all the time for an extra one. I haven't seen the other ones for 15 years or so. I saw this extra one—that would be about—we moved about 1917, I would say we moved from there, and we discarded a lot of parts. We had an awful lot of parts in our stock room. Every time we moved from one place to another we would discard some; we didn't want to carry so many parts around.

I haven't the slightest interest in this case or in the outcome of it. I do not know who the parties are here in Cleveland that are sued, I do not know either one. I do not know anybody connected with Sterling Products Corporation of St. Louis.

Mr. Bruninga: That is all.

CROSS EXAMINATION by Mr. Richey.

We junked the parts that the Staver Company discarded from time to time, sold them for scrap iron.

That piston like Exhibit 3-V, that I said was around there about 1917, had slots in it. That was junked. You see, I had charge of the stock room. When the carriage business went out of business and sold it to the Staver Motor Car Company, we bought, oh, gosh, I don't know how many carloads of parts, you know, frames and fenders and motor parts, and we just had two big stock rooms, and we had the establishment piled up with rear axles and axles and radiators, and one time I discarded parts that weren't sold, back for 1915 or '16 parts, that we didn't sell, we just discarded. In 1914 when we organized the Staver Motor Car, we moved in another department of the Staver Carriage Company, we moved this stuff, and we didn't want to keep it, so stuff that wasn't salable I just threw them away.

I said that after the company quit assembling motor cars, it went into the service business, that is, they supplied parts for cars they had assembled. We supplied the pistons as substitute parts or repair parts during that period. We supplied pistons for Teeter motors. None of them were slotted.

The time that Mr. Monckmeier took the pistons out of that four-cylinder racing car before the Elgin races in 1911 and slotted them and put them back in, that is all he did to those pistons at that time, but we did change the rear axles and put in different kind. The rear axle was changed before the race. We didn't have any trouble with the axle, but had trouble with the motor.

Between the time the car came back and the time it was used in that bowl, we took the pistons out that had been slotted, and put in standard pistons which weren't slotted. Then we took the slotted pistons, all five of them, and put them in the stock room. They were laying around there for a long time because I had a certain place for the racing parts. You see, we figured if we did go into the racing game, we would build a six-cylinder car. The slotted pistons we took out were never used again. We built only the one car after that, the Betsy, and the pistons we put in there weren't slotted. Neither did we put slotted pistons in any other car that the company assembled. As far as I know the Teeter Company never did. That is all I heard of this slotted piston until Mr. Monckmeier came to me a little more than five

years ago, about seven or eight, I would say, and mentioned it to me. At that time he told me "If anybody ever comes to you, just don't say nothing about it at all." He didn't give me his reason for not wanting me to talk to anybody about it. He said, "The only time you want to talk is when you get up on the stand."

Q. He contemplated litigation about it, then, because he contemplated you were going on the witness stand? A. He said, "You may have to go to New York." He said, "Some company is suing another, and you may have to go to New York on the case." He said, "Don't say nothing until you get on the stand, or explain anything." I said, "All right."

(Narrative continued) Gus Monckmeier prepared the affidavit for me. He wrote it up for me, and I signed it as he wrote it up. I have testified here in accordance with that affidavit.

Q. Who was it that drilled these holes in the Teeter piston that you used in that four-cylinder car? A. Well, my brother was a machinist. We had a machine shop there and my brother was the only machinist that we had, and he worked. I know he worked on an awful lot of those parts. He built motors, assembled motors, worked on the motors.

(Narrative continued) The Elgin race in 1911 was the only race I saw. I didn't inspect apparatus for the company. Gus Monckmeier was the experimental man on the parts; in other words, when anything special was up he had to take the cars, drive them around, see if they would hold up. That was his job. His recommendations were adopted by the company. You take a car, and if you have a special rear axle, he would take it out and see if it was all right and report what kind of condition the rear axle was in. We had trouble with the Salisbury axle. The Salisbury didn't hold up, so we finally used the Hess. The Hess seemed to be the better axle. Our company relied on Mr. Monckmeier to make those tests, and on his reports.

The attorney said that he would pay my expenses down here. I work for myself, buying and selling cars, wasn't doing anything. I told him I would come down if he paid my expenses down.

The Staver Company is still in business. I left them in 1930 to go to work for the Chicago Motor Club. I

worked there from November, 1930, to November, 1932, two years, in the service department, floor man in the service department, and the Motor Club was getting slack, so they were going to lay off a man that worked for 15 years and they didn't like to do that so they give him my job and let me out because I was one of the youngest ones.

Mr. N. E. Dexter was in charge of the Staver Company back in 1911, '12, '13, '14, and '15. He is still, he is manager. They call it the Staver Auto Service Company. He is still with them. He wasn't the manager until 1914, until they organized the new company called the Staver Motor Car Company. Mr. Roy Staver had been manager prior to 1914. He died about 1916. Before that we had so many men around there; Mr. Teeter at that time had charge of the experimental department, and Mr. Joe Lynn was, I believe he was the manager back from 1912 and '13. I think it was Ralph Teeter, I wouldn't say for sure. Some relation of his made the motor. I heard he was with some piston ring company, if I heard the name—Perfect Circle, I think he is with the Perfect Circle. I don't know what city.

I haven't seen Joe Lynn since 1914. I don't know where he is.

Mr. Monckmeier reported mostly to Roy Staver. He was one of the big shots there. Whatever he said there goes. Roy, and Harry, Mr. Harry Staver is president; he is still living today. I don't know whether Mr. Monckmeier ever reported this slotted piston to Mr. Staver.

These slots were cut in the pistons in the 1911 Elgin race car with a hack saw. I wouldn't say I saw them cut in there. I was in the stock room. The stock room was right next to the machine shop.

Q. You said something about Mr. Monckmeier telling you he burned out some pistons before this change in 1911. You didn't see those burned out yourself? A. No.

Q. All you know about it is what he told you? A. Yes. Well, I know they were burned out, later, because they brought them in and we had to tear the pistons out, but I didn't see them burned. I know they were burned out, though, scored.

(Narrative continued) That was about a week after the race. We didn't tear the motor down, just threw

them in the shed, and they had to use the men to get ready, to get the race cars going; after the race they began to tear these motors down. They burned the pistons out on time trials before the race. They didn't run the same motor in that race, they used a different motor.

I didn't see those pistons that were burned out when they made the motor; that was done at Hagerstown, Indiana, the Teeter Motor Company had built the motor. We didn't build them. I don't know what the clearance was.

Q. Between the time that the pistons were burned out—those motors were taken out of the car? A. Yes.

(Narrative continued) It was the same car that the slotted pistons were put in. When we put in the new motor we put slotted pistons in there for the race. The car had run before the pistons were slotted; it ran maybe six times around in the time trial, the same kind of run that the car was run on when these pistons were burned out.

The only car that finished in the race was Monckmeier's car. The others burned out. Well, the cylinders cracked on one, although I remember that distinctly. It froze up and the cylinder cracked. And on the other car, gosh, I know it didn't run, it was just froze up. I don't know whether they broke the block or anything on that one, but one of them broke a block, froze up solid, in other words, broke the cylinders. Gus's car was the only one that finished the race. I don't remember how many cars were in the race. Three of Staver's cars went into the race, and that was the only Staver car that finished the race. A lot of others finished, though.

The Betsy car finished in all of the races when it entered. We didn't race that in this race—that raced in a lot of these fair grounds. Monckmeier drove that for a couple of years. Mr. Monckmeier drove that car for us for a year before we sold it to him. We never had any trouble with the motor, had trouble burning out the bearings, nothing with the motor, cylinder walls, or anything like that sticking.

These racing cars are built so as to sacrifice everything for speed. It is kind of a special job. It is not very much different from the pleasure car. The only difference was this Betsy had a 45-frame, four-cylinder frame, which was shortened up, shortened it up about

two feet shorter, cut out a piece of the frame, because I had to work on that, and put a six-cylinder motor in, and had to shorten the propeller shaft. We did such things as bore holes in the pistons, sacrificed weight and the strength that went with it for the speed that went with the racing cars. The pistons, cam shaft and ring gears, that is the only three changes we made.

Mr. Richey: That is all.

GEORGE ELLINGHAM, a witness called by Defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Bruninga.

My name is George Ellingham. They call me "Red," they always did. I live at 543 Englewood Avenue, Chicago. My age is 42. I came to Chicago in the first part of 1911. I started to work in Chicago then, at Staver Carriage Company. I started the same year I came to Chicago.

The Staver Carriage Company, besides carriages, were assembling cars, automobiles. The car went under the name of "Staver." It was also known as "Staver-Chicago." They had that on the shield. That car had a Teeter motor in 1911, of four cylinders, and the bore of the cylinders was about $4\frac{3}{8}$ or $4\frac{1}{2}$; they carried the two sizes. I don't know the length of the stroke. It had a splash system of oiling.

The Staver Company had three or four racing cars in 1911—I couldn't say just how many. I knew some of the racers. I know Monckmeier and Ireland; I didn't know Ireland as well as I know Monckmeier. Ireland was a racer in 1911. Mr. Monckmeier of whom I speak is Gns Monckmeier.

I attended the Elgin automobile races in 1911, which was a big race. I am pretty sure that was in the summer. No one was hurt at that Elgin race, but in the trial spin, Ireland was killed, preceding the races. He was the driver of a Staver car.

I was a machinist at Staver's in 1911, in the machine shop. My duties were bench work and lathe work and all around—drill press, shaper, they had, just a small machine shop. I was about 22 at that time. I had had about four years experience as a machinist before I came there.

I did some machine work for Gus Monckmeier before the races. I helped him saw a slot in the piston, sort of a T-slot he put in there. It was a cast iron piston, the same cast iron piston that was used in the car. That piston had wrist pin bosses inside there. That slot was sawed about a quarter of an inch below the lower ring, and there was a hole put in about half-way down, and the slot was sawed to one side and over on the other all the way through, sort of a zig zag slot. That made a T with the one on the top, just one T. The top of the slot was about a quarter of an inch below the lower ring. The down-stroke of the T just went over to the opposite side of the hole, as though one to the hole was up on this side, and the upper one on this side (indicating). That slot went clear through the piston wall, as did the vertical slot. The vertical slot was between the wrist pin bosses. I helped Monckmeier saw that piston, right on the bench, right where I was working. I slotted four or five pistons, to my knowledge.

I wouldn't swear that that T-slot was on both sides of the piston. I am pretty sure it was. I just remember sawing—it was something new to me to see him do something like that.

I had seen these kind of trunk pistons like that in the Teeter motor before that time. I hadn't seen the ones with the slots, but just the regular pistons. I knew that it was a Teeter piston these slots were made in. I knew those pistons pretty well. I had seen quite a few of them. I am sure of at least one slot. I wouldn't say on both sides, but I am positive they were on one side because I remember that very well.

I asked Monckmeier the reason for putting the T-slot in, and he said for contraction and expansion, so if the engine would run hot, it wouldn't freeze in there. That was his idea in doing that. I asked him, and that is how I found out. After they were through racing, they took out the pistons and put them in stock some place. I never saw them after that. After we had slotted them, he put them in the motor. I saw him take them over and put them in the motor of the racing car. That was a few days before he was going to race at Elgin. You see, he used that car at the Elgin races. I don't know what became of the pistons afterwards. I don't remember of ever seeing them after that. I never paid any attention to that.

The Staver Company continued to build cars until about, I guess about 1914, when they went out of business. I left their employ about 1915.

The Staver Carriage Company changed its name into the Staver Motor Car Company. He wanted to put it all over in his name, I don't know how they did; I know they changed the name, I should judge that was a year or so before I left there. There was a six built later on by them, during the period I worked there. I think it was in 1912 we began building the six. That had a six-cylinder Teeter motor. I couldn't swear as to the size of the bore of the cylinders of that six-cylinder Teeter car. I think it was 4 or 4½, I am not sure.

I know about the car known as the Betsy. That was a racing car. Monckmeier bought and raced it himself. I saw that car. I think I did some work on it, I am pretty sure I did when he was building it. It was a six with a Teeter motor.

The piston Exhibit 3-V is the type which we used in the four-cylinder racing car, one like this. Only the slot wasn't as wide. We just had a hack saw.

I don't recall whether or not those ring grooves were used in the four or six-cylinder car.

The slots in Defendants' Exhibit 3-V piston are about the same as Gus Monckmeier and I cut in the pistons before the races, only this slot is down a little lower, and we cut it all the way through; that is just hanging on there on one side.

Q. You say this horizontal slot, then, circumferential slot below the ring land, it was a little lower down?
A. About a quarter inch below there.

Q. You would say about a quarter inch lower than the ring groove?
A. Below the ring groove.

Q. How about the vertical slot?
A. That was just about like this, sort of staggered.

Q. How about the holes?
A. The hole wasn't that large, only a half inch hole. I know it wasn't quite that large.

Q. Did you see any of the pistons that were used in the six-cylinder car that Gus Monckmeier took, or the Betsy?
A. I have seen the pistons but I don't recall whether they were any different.

Q. I mean in that particular car that Gus Monckmeier took?
A. In the four-cylinder?

Q. No, in the six-cylinder, the Betsy?
A. No, I didn't see those.

Q. You would say then that the pistons that Gus Monckmeier used in the Staver car in the Elgin races were slotted the same as that Exhibit 3-V; is that right?

A. Yes.

(Narrative continued) All the Staver cars didn't finish the race at Elgin in 1911; I am not sure; I don't know if they did. I do remember that particular piston. The reason I remember that particular slotting is because when I recall of sawing it I was wondering what he was going to do, such a foolish thing that I was going to saw the piston in two, that is what I thought when I started out; that is what made me remember it. I remember asking him about it. I was helping him. He was sawing it kind of crooked. I was kind of engineering to get it straight. He was always in a hurry for everything, you had to jump when he wanted something.

You got in touch with me through my brother, who told me to call you when you were at your daughter's in Chicago. That was just about a month ago, something like that. It was two weeks ago last Saturday, that is right. My brother phoned me. I was out at the time. He left word to me for me to call you as soon as I got in. A number was left for me to call you. When I called you you asked me what I knew about this Monckmeier piston, and I told you at that time what I knew about it. It was not a bit different from what I have been telling here.

I haven't seen Gus Monckmeier in 12 or 15 years.

My brother did not tell me how that Monckmeier piston was made. He just mentioned something about a piston over the phone and asked me if I knew anything about it. Then I thought for a minute and it came to me and then I called you.

I haven't seen that particular piston, Exhibit 3-V, at all before today, nor have I seen any photographs or drawings of it before today.

I haven't the least idea what parties are being sued here. I have no interest whatever in the outcome of the case. I do not know anybody connected with the Sterling Products Company, or the Ray Day.

My brother's name is Herbert Ellingham. He is in Cleveland now.

Mr. Bruninga: That is all.

CROSS EXAMINATION by Mr. Richey.

My brother didn't talk about or tell me about an affidavit he executed for Mr. Monckmeier five or six years ago; he never talked to me about any of that.

We both live in Chicago. Sometimes I don't see my brother in two or three weeks, but on the average I would see him once a month, socially. We have not worked at the same place, nor did we five or six years ago. We do not live together now, nor did we five or six years ago.

My brother didn't tell me that five or six years ago Mr. Monckmeier came to see him; he never mentioned anything that I recall about these pistons I have been testifying about. He didn't tell me Mr. Monckmeier told him not to talk to anybody about these pistons; he has never said anything to me. I have not talked to him about these pistons in the last ten years. We came down on the train together. We talked a little about these pistons on the way, you know, just offhand. I didn't pay much attention, just told him what I thought.

I made my arrangements to come down here with him. We then talked over what we were coming for. We talked about pistons just in the last two weeks, when I knew I was coming down; I didn't know for sure. When we get together socially we talk over different things, but we haven't talked about this piston until recently. We talked about almost everything else. We talked about a lot of different things but never talked much about pistons or anything like that.

I used a hack saw blade when I cut the slots in those pistons used in the four-cylinder engine. When I used the hack saw blade on those pistons I put them in the vice, not a very strong grip on them, very little, with a shield so I wouldn't nick them up. We drilled holes in those pistons that we slotted, similar to those shown in Exhibit 3-V.

I don't know just exactly what the clearance was, in that four-cylinder car in which we used these slotted pistons, between the pistons and the cylinders. I don't know what clearance there was in the other cars, the regular cars made by the Staver Company.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

I have told here in Court what I remember. My brother did not tell me what to say. He never had nothing to do with it. You told me to tell the facts when I

came into Court, what I knew about it, and when I go any place I do that.

My brother and I did not discuss all the details of the slotting, we just knew what we was supposed to come down here—we never discussed anything about the details of the pistons. He didn't tell me anything, nothing about that.

I said my brother and I came down here on the train together. I didn't get the question. We drove down.

Mr. Bruninga: That is all.

(Adjournment to following day.)

(At this point testimony of PERFLER, Record pages 273 to 274, was taken.)

(Thereupon, at 1:30 P. M. Thursday, February 2, 1933, the hearing was resumed.)

ROBERT W. D'VORSKY, a witness called by Defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Bruninga.

My name is Robert W. D'Vorsky. I was born in 1892. I am engaged in the manufacture of airplane propeller type fans, electric fans in the city of Chicago. The name of my company is "Super Air Screws." I am a partner in the firm, partnership.

My general education after graduating from school, is one year at the University of Iowa, in just the liberal arts.

I know Gus C. Monckmeier. I think his home is in Davenport. His business is in Rock Island, Illinois; I believe his home is in Davenport now. I first met Mr. Monckmeier in San Anton, Texas, in 1912. He was there to race an automobile at the races being put on there at that time. I was there with a partner, we were selling magazines at that time, and the way we became interested in these races is through a fellow we met in the hotel, and that way I met Mr. Monckmeier. Mr. Monckmeier drove a Staver car in that race. That car was being manufactured in Chicago. Though I found that out later, I don't remember of knowing it at the time. I would say it was a year later, when I called at the Staver factory in Chicago. At that time I saw the Staver car that Mr. Monckmeier had, which was a bigger car than he earlier had in San Antonio.

That car I saw at Chicago had six cylinders. I saw Monckmeier off and on after that; I would see him once in a while running in a race. I saw Monckmeier in 1914. I don't remember clearly where I saw him first in 1914. I think I remember of having seen him somewhere in some races, but the time I do remember distinctly was at Iowa City, Iowa, early in the fall of 1914. Iowa City was my home town, and my oldest brother was helping promote an automobile race there, and he had asked me to come back to handle the advertising for them. I went back to handle the advertising in 1914. As I remember it, I was told Monckmeier was in Iowa City at that time reconditioning his car, and was told at what garage he was there, so I went down to see him. Sjdwell's garage was the name of it. I found at that garage that Mr. Monckmeier had his car pretty much dismantled, and just generally reconditioning it, everything; spent quite a little time on it, and I helped him some reassembling the parts. That was a Staver six car that I first seen in the Staver factory at Chicago. That car had the number nine, I remember very distinctly. I remember the general appearance of that car and would recognize a picture of it. The postal, marked Defendants' Exhibit 4-P, is a little hazy, but the second car behind is the car that I saw in the garage. I can see that number nine on that car. That is a Miles City boy in the car, a great friend of mine. Sam Wilson was his name. He was in that Iowa City race. I didn't see all of that race, because I was busy with things that required my attention so I couldn't watch the race steadily. At that Iowa City race I was up in the judges stand part of the time and helping in various ways. I had the program concession and I had to be checking in the boys and sales.

Referring back to the garage where I saw Gus Monckmeier's Staver number nine partly dismantled, I particularly saw the pistons we put back in the car at that time. They were aluminum and there were six of them. The head of those pistons were concave. I remember that there were a series of holes, round holes, around the skirt of the piston, and then the slots, sort of a T-slot cut into the piston. You see there were two T-slots, one on each side, at right angles to the head, but I don't recall that perfectly, that they were right at those angles.

I never heard the expression "thrust face of a piston." I know what the wrist pins of a piston are, and I know how they are arranged in a piston. The wrist pin

bosses that carry the wrist pins are arranged horizontally in a piston. I didn't notice any particular difference between the way the wrist pin was arranged in those pistons and any other piston, the location of those rings in it. The general location of a wrist pin in a piston, I would say, is about half-way up the piston.

The horizontal of that T-slot I was talking about was at the top—not the top of the piston, I mean above the wrist pin holes. It was below the ring grooves. The vertical of the T was at right angles to the grooves. I wouldn't say it was exactly in the middle of the horizontal slots, but as I recall it it was practically in the middle. I am not sure how far the vertical slot went down toward the end of the piston. It went into, as I recall, into one of these round holes, which were about, I would say, half an inch or three-quarters of an inch in diameter, and then I don't remember whether it was a continuation of that line that went to the bottom of the piston—it seems it was more of an offset.

Q. It was an offset, but did the slot that ran up and down, did that stop altogether then at one hole?

Mr. Richey: I object. He said he didn't remember.

Mr. Bruninga: Question withdrawn.

(Narrative continued) I think I can draw how that T-slot looked, on a piece of paper. (Witness makes sketch on paper marked Defendants' Exhibit 4-Q of what he remembers of that piston and the way the slot was arranged.)

Q. Now, will you locate on that just about where the wrist pin line would be? A. (Witness complies.)

Q. How about on the other side? A. (Witness makes further sketch.) This may be made a little longer in proportion to the width of the piston.

(Narrative continued) 1 represents the wrist pin holes, 2 is a ring groove; that is a separation between, ring groove. 3 is the top line of middle ring groove. 4 is the horizontal slot of the T. That went all the way through the side wall of the piston. 5 represents the vertical slot hole. 6 represents one of the holes that were—there were several of them around the skirt of the piston. 7 represents the vertical slotted hole, again. The slot 5 went all the way through the wall. 7 also went through the wall.

The line 8 represents the bottom of the piston. It is my recollection that the slotted hole 7 went all the way to the bottom of the piston as I have shown it. That piston is the one I saw in the garage in the fall of 1914 in Iowa City. I think the pistons were on the bench when I first saw them, but I am not sure of the exact location. I think they were all out of the motor. I believe there were six, but there may have been more than that. I know there were at least six. That was before the Iowa City race. Those pistons were put back into the motor. I helped a little bit on that motor. I don't recall so clearly if I saw them put back into the motor or not, but I was there when the assembly was made. I remember the difficulty that Mr. Monckmeier had assembling the pistons and putting them back into the cylinders.

Monckmeier used that car in that Iowa City race. Monckmeier saw that I noticed those pistons. We discussed it.

Q. You discussed it. What did he tell you, if anything, about the pistons in that discussion?

Mr. Richey: I think that would be hearsay.

Mr. Bruninga: Oh, no, your Honor, this is an exception to the hearsay rule in patent cases because it is a question of disclosure.

Mr. Richey: Well, I think if you limit it.

(Narrative continued) Mr. Monckmeier answered several questions I asked him about the pistons, because that was so unusual that I asked a lot of questions. He said he wanted more flexible and lighter reciprocating parts to do it, for he would get better performance, higher speed from his car. Mr. Monckmeier didn't explain any too much in detail, any more than answered the questions that I asked, because I was so interested. I don't recall that I saw those particular pistons after that time, although I do recall seeing Mr. Monckmeier working on his car the following season, with the motor down, but there was nothing then to make me pay much attention to any one part of this at all. I have never seen any of those pistons since that time. I have seen no pictures of them. I have never discussed the construction of those pistons with anybody. You asked me to tell you how they were constructed, you didn't tell me. I believe I would recognize one of those aluminum pistons if I saw it.

Q. Well, here are a bunch of pistons on this table, about twenty-some of them? A. I believe that is the piston (indicating Exhibit 3-W).

Q. You believe that is the piston. How about the T-slot in that piston, is that your recollection of how it looked in the piston that you saw in 1914? A. Well, it wasn't quite that crude.

(Narrative continued) I didn't recall it was that way, but that looks like the piston all right, one of the originals. That head I remember very distinctly. I remember those T-slots were placed like that in that particular piston that I saw. I do not remember positively about the piston rings in that piston. I believe he had two rings in this groove, in the lower groove, though that seemed to have—no, that is cut away. I do not know that the make of that particular ring is in that groove. I don't recall the rings clearly, but I had the impression they were narrow rings. As far as my memory goes, that is one of the particular pistons that I saw in the garage.

I was following automobile races after Decoration Day, 1915, until the end of the season. We started in Coffeyville, Kansas, and then we worked into Missouri and Iowa and Minnesota, some in western Illinois. I met Monckmeier frequently that year. In most of those races in that territory, I handled the advertising or program concessions; others I promoted the races myself. Monckmeier was driving the Staver car; still Staver number nine, the same car. He was driving in those races.

There was a race at Anamosa, Iowa, during 1915. I believe it was around the 4th of July, it wasn't late in the season, I know. Monckmeier ran that Staver number nine car at that race. There was a motorcycle rider that was injured at that race, and I believe he died after that from his injury, though I am not positive of that. There were motorcycle races preliminary to the automobile races in Anamosa.

I have heard of a man by the name of Lyon who drove a Ford special. I believe he drove in that Anamosa race, though I couldn't say positively. I know he was there. I know a man by the name of Phil Shaffer who was also a driver in that race. He drove a Chevrolet.

Frequently there would be an occasion when the hood on Monckmeier's car would be raised on the track for minor adjustments, where we would all look, of

course. He didn't use a fan in his car at that time. I never saw him get stuck on account of the pistons seizing.

Those races in Iowa were not sanctioned races. They were called non-sanctioned races. By that I mean the three A's ruling on eligibility rules were not observed by the promoters of these races, or the drivers that run in them. They were more just like "wildcat" races.

Part of 1916 I was selling Chalmers cars.

Monckmeier's piston with the T-slot was discussed in the presence of Mr. Monckmeier with others at different times. In 1916 the Chalmers cars had aluminum pistons in them, and I remember discussing that with one of their engineers, that this car had been equipped with these pistons, slotted, a couple of years before that time. I don't remember distinctly whether I went into details on how that slotting was done.

Mr. Bruninga: I want to mark for identification a photograph of the front page of the Anamosa Journal, Anamosa, Iowa, dated Thursday, June 10, 1915, which contains a report of this race that the witness has been talking about. The same is marked for identification Defendants' Exhibit 4-B.

I would say Monckmeier was frequently in those races in 1915. I would say he won money in a majority of races, a big majority of races.

(Short recess taken.)

I have never seen the Anamosa Journal, Defendants' Exhibit 4-B, before you introduced it here. I don't think I have seen any Anamosa Journals since perhaps in 1915; I don't know for sure. It is a small town paper. I didn't take much trouble reading small town papers like that.

When you talked to me about this matter and tried to find out what I knew about these things, I gave you the names of Lyon and Shaffer when you asked me who was there. I told you what kind of cars those men drove.

I don't recall that I ever saw any of Monckmeier's cast iron pistons.

Q. You saw this particular piston here, Exhibit 3-V, on the table, didn't you, and you didn't pick it up at the time you picked up 3-W? A. Yes. Their position is moved now. I didn't see the bottom of that piston before.

Q. Well, you might examine that 3-V, which is an iron piston. Can you tell me now whether you saw any of Monckmeier's cast iron slotted pistons? A. I don't believe I ever did.

CROSS EXAMINATION by Mr. Richey.

As to the length of time I followed these automobile races, the first one was in 1911—or '12, and the next one in 1913 in California, and then after I got back I don't believe I had any connection with any races until in 1914, perhaps two or three was all that season, and then the entire season of 1915, and then after that I dropped out of racing. After that I went into selling automobiles, and advertisements. The only car I ever sold was a Chalmers car. I started selling that some time in the spring of '16. I believe I sold that car until the early fall of that year around Iowa City, my home town in Iowa.

After I discontinued selling cars, I started selling advertising again. I got back into the automotive line, tools, selling tools in Providence, Rhode Island, in 1917, and went into the service.

I have not been connected with the automobile business since 1922. When I returned from the service my health was poor; I was inactive for those first three years except for selling some tools. I sold some that this fellow Monckmeier manufactured, and then others that were manufactured by my former connection at Providence. I saw Mr. Monckmeier when I was selling those tools. I would say I sold for Mr. Monckmeier from 1920 to '22. After '22 I engaged in the manufacture of ventilating fans. I kept that up until about two years ago, I started in business for myself making fans.

After 1922 I very seldom came in contact with Mr. Monckmeier. I don't believe I saw him over two or three times since then.

I don't recall the name of the man with the Chalmers Company to whom I spoke about aluminum pistons. The Chalmers car at that time was equipped with just a solid wall aluminum piston. It was something like Exhibit 3-H, except it was of aluminum. Those pistons had been giving us trouble is the reason we discussed it; they gave a lot of trouble pumping oil. The factory engineer's calls down there were more or less general. I don't believe that he came there particularly on account of that trouble; as I remember it he was inclined to of course maintain that the car was all right. We reported the trouble to him that we had been having. Our customers had been complaining about it. I remember mentioning to this engineer about this slotting of the Monckmeier pistons, that Monckmeier used an aluminum

piston that he had full of holes in the skirt and slotted. He didn't seem to be impressed by it, at least, just casual. Nothing was said about it that I know of, because I left the company shortly after that. I don't recall definitely whether they continued to use this trunk type piston or not. I recall something was done in the refinement with lynite, and so that they had some of those troubles eliminated. I don't know whether or not they went back to the iron piston. I don't think they did.

I knew later of the use of the split skirt piston. I have known for some time that that use was quite general.

I met Mr. Monckmeier at San Antonio, Texas, in 1912, in the fall. I don't recall accurately what month. I presume it was about September or October. I am not positive that it wasn't November. I know shortly after that—I know we landed in California on Christmas Eve, in Los Angeles, and we made a few stops in between. I don't remember exactly whether or not it was warm in San Antonio at that time. I don't think it was anywhere near freezing.

The race in Iowa City that I spoke of was in the fall. I wouldn't remember what month exactly. It seems it was Labor Day that this race was held, but I wouldn't be positive of it. I don't know exactly how many cars were in that race. There were usually about six or eight cars entered, the number varied. I don't recall how many races there were; usually about four—three races. Monckmeier usually took part in just one race. I don't know which one particularly. They usually had a light car race and a heavy car race. I know Monckmeier raced there at different times beside that, but I don't recall how many he participated in at Iowa City.

The money prizes in those races depended upon the promoter and the length of the race; sometimes there would be three moneys, four. When I said Monckmeier was in the money, I meant he was high enough to get some part of the money, just like you say a horse gets a ribbon, but it may get a yellow ribbon.

I don't recall definitely when I talked with Monckmeier about this piston, but I remember one time when Monckmeier said he wished he had done something about that slotted skirt on his piston; that is about all that was said. He asked me to give him an affidavit about it at one time; he asked me, if I remember rightly, over the phone, and then I never met him to even talk about it.

afterwards. He did not ask me not to tell anybody about it. He was not very talkative about the piston when I saw it. He was inclined to keep the information about it to himself; he answered my questions reluctantly at first; he didn't elaborate it much.

I don't know what the clearance was between the pistons and the cylinders in his car which I saw at Iowa City. I think that was a Teeter motor used in that car; I am not positive of that, though. It is pretty hard to remember these things all these years. I don't remember what kind of a magneto was used on the engine.

It wasn't common at that time for racers to use no fan on the motor. It is not necessary after they get going, to use a fan. The other drivers wanted Mr. Monckmeier to use a fan because he smoked so much. The engine that he ran with those pistons in it smoked a lot, and they always protested; they stand so close. The smoke from his exhaust was very bad, so that there would be foggy air around the judges stand and other cars, and the drivers complained about that fog being hovering there when they came around to the next lap. It reduced the visibility, and they claimed it increased the danger of driving. I saw the smoke myself; that argument came up quite often. The other cars didn't smoke that much.

I don't know whether or not it became common practice after that for the racing drivers to leave the fan off, because I didn't follow racing enough to check on those details, after that. There seemed to be a difference of opinion at that time as to whether or not a fan was needed. The speed of the cars in those races depended on the track. I would say a good average speed for the races I saw was a mile a minute. Some drivers considered the fan a useless complication on these old cars at that speed. Monckmeier apparently considered it such, for he refused to put one on.

That engine that Monckmeier had in his car had a big cylinder as compared with pleasure cars and those that have been used since.

Q. And when you looked at the pistons on the table there, there were only two pistons of the size that were used in racing cars of the day that you speak of, that is correct, isn't it? Want to see them again? A. Well, no, they were all sizes; some of them were smaller pistons. Of course that car of Monckmeier's, that Staver, and Stutz cars, those had big pistons, but the Buick and some of those—

Q. Well, on the table, when you picked out these, there were only two pistons of the size that were used in Monckmeier's car; that is correct, isn't it? A. I didn't check the sizes very carefully.

(Narrative continued) All the rest of the pistons look to be smaller. Monckmeier's car had unusually large cylinders, although there were some that had larger cylinders than that. One was the Sloan's bunch, Alex Sloan, he had a car, a J. I. C. built by the J. I. Case Company for advertising purposes; it had cylinders much larger than that one. The first one was a four. I don't know the bore of that Monckmeier car. I know the Stutz had a $4\frac{1}{4}$, I think, bore. Some of them were rebored larger, of course, for racing purposes. I don't know off-hand any others. The Ford, as I recall, was $3\frac{3}{4}$ " bore at that time. I believe the Chevrolet was a sixteenth smaller, something like that, I am not sure about it. The Buick was smaller than the Monckmeier car, and also the Hudson was smaller.

I arrived in Cleveland early this morning.

I don't know definitely how many of the races at the Anapocsa meet Mr. Monckmeier participated in, but I presume one; I don't remember. They were racing quite frequent, some programs would call for two or three races, sometimes shorter races, each class.

I don't remember how the wrist pin bosses were connected to the other parts of the piston in that Monckmeier aluminum piston that had a split skirt. I don't remember how they were connected to the head. I don't remember whether the skirt was uniform in thickness from the bottom up to the head, or whether it varied in thickness. I don't remember whether the round holes in it were all of the same size or different size; that is too much fine detail. All I remember, I know there were a series of holes there, and that is what attracted my attention to them in the first place. I do not know how the slots were made in that piston; they apparently were sawed. I wouldn't say they were as smooth as sawed slots. If handled carefully, a saw generally makes slots with smooth sides.

In metal, I believe you could saw smooth or rough, depending on your skill. A metal saw is the same as a wood saw, it has a lot of teeth on the bottom and smooth sides. I wouldn't say that when you saw a slot with a wood saw you always get a slot with smooth sides, whether you saw straight or crooked. I have sawed a

slot with a saw that had irregular sides. The redressing over the edge will make some irregularities if it is not done real carefully. Sawing in metal is not particularly different than sawing in wood, so far as the size of the slot is concerned.

I didn't examine all of those pistons, that had the slots in them, carefully to make sure they were all exactly alike. I was too interested in the general differences that I noticed. I don't recall if I helped to put them in the cylinders; maybe I did. I am positive that some of them were put back in the cylinders while I was there; I don't remember if all of them were, but I remember hazily some difficulty he had in getting those pistons back in. I don't think he put them back in all by himself, but I am not positive of that, either. I have forgotten his motor, whether they were put in from the bottom or from the top; I don't remember if they were put in from the top or bottom.

Q. But when I asked you you tried to figure it out by remembering what kind of a motor he had, and how they would be put in in a particular type of motor? A. That is too much of a detail to remember.

(Narrative continued) I am pretty sure the connecting rods were on them when they were put back in the engine; I am not positive of that, however.

I do not know what kind of rings were on the pistons. I am not positive whether the rings were cut on a bias, circumferentially. As I said before, I thought there were two rings in that bottom slot, but I have no way of recalling that definitely. I don't remember whether or not there were any ribs in the head of the piston. I remember the head. I remember asking Mr. Monckmeier if that metal was sunk in the casting. I don't remember what his answer was to my question on that, but it had some advantage. I have forgotten what he said about it.

The purpose of these drivers making the changes all the time in the cars was to secure a little better performance. What they meant by performance was power, which meant sustained speed. They were looking for parts that would stand up and keep running.

Q. But they had to have great power when they were running to get more speed, didn't they? A. Well, I don't know how to answer that question. Some of them had, theoretically, a lot more power than others, still they weren't capable of going as fast.

(Narrative continued) I don't remember how long that Anamosa race was; these feature races were usually 50 miles, sometimes they would have a 100 mile race, but not so often on a half-mile track; sometimes there would be just 25 miles. They tried to make them shorter, but sometimes the promoters would insist on the longer races. I don't remember how long the race at Anamosa was that Mr. Monckmeier took part in. I don't remember how long the next race was; I didn't know there was a next one. Usually the race Monckmeier was in was the last race of the day. That was a heavy car and the longest race and most money up.

I don't know what caused this Exhibit 3-W to be crushed in on one side and broken in on the other. I have heard of pistons breaking in a race. I don't know how they break in the races. They break in different ways; flaws in them; if they seize something has got to give. I don't understand the rule of breaking.

The slots which you have just shown me do not look like saw slots. They made those irregular like that in order to get started.

Referring to the pistons I saw at Iowa City, I don't know what the outside of the skirt below the ring looked like; I wouldn't know that; I wouldn't remember. The impression I had was that the vertical slot ran into one of these round holes, and then the part on the other side of the hole was offset from it and ran into the hole. I have a dim recollection of Monckmeier telling me that it was off to the side intentionally for some purpose, but I don't remember it exactly, what it was. I don't remember of asking why he ran it into the hole; he didn't explain much that I didn't ask him.

I don't remember if those pistons had webs on the inside. I don't remember if there were any grooves on the inside of the piston; I don't recall the inside at all, or any fine points of it, its detailed construction.

I don't recall whether or not the bosses were curved into the inside of the skirt. I don't remember how the holes were arranged in that piston; I don't remember whether or not they were arranged in rows, circumferentially.

I have been here this morning with Mr. Bruninga and Mr. Sutherland, and have talked this matter over with them.

I said the upper part of the vertical slot went into the hole on one side, and the lower part went off on the

other side. That doesn't seem to be true of Exhibit 3-W; that is just the impression that I had of it.

Q. Now, there is a jag in the slot, but it looks like it was made by twin borings or two borings of the tool, and then the only hole in the piston that connects up with the slot is near the bottom of the piston, isn't it, and the slot is there, what you might say tangential to the hole; that is correct, isn't it? A. Yes.

Q. Goes along one side of it? A. Yes.

(Narrative continued) I didn't mean to say definitely the pistons were on the bench there in the garage at Iowa City. I just presumed they were. I knew some were loose. I first noticed those holes in them and started asking questions because I had never seen anything like it. It was the holes that first attracted my attention to it. I don't know how long I was in the garage at that time, exactly. Monckmeier was there for several days and I would drop in and see him often. I think it was about 1920 or so, somewhere around there that Monckmeier said to me that he wished he had done something about this slotted piston. I believe it was after 1920, too, because I believe we were discussing a Maxwell car that had a slotted piston in it. I remember something about a car using a slotted piston. Of course they had no clearance as shown in Exhibit 1. I don't have just that offset, I don't remember those offsets being used that early. He said he was sorry he had forgotten about this thing and thrown it away and abandoned it, in view of the fact he had seen this Maxwell piston, or words to that effect. I think that was at the time he was still experimenting with a composition piston. He had, I remember one time he had various metals—aluminum alloys and he had a, I think a bakelite. I presume he was trying to get a light piston that wouldn't slap or stick; I don't pay much attention. I wasn't very interested in it.

Mr. Monckmeier was manufacturing some tools that I was selling for him, with other lines, but I don't recall just at that time that we discussed pistons. I just remember it was discussed sometime after; it may have been. He showed me some of the composition pistons he was working on, told me he was working on more in his shop there. I believe they were trunk type pistons. Of course that term excludes some of those others. I don't know the limitations of this truck type—does that mean without this offset?

Q. Yes, it would mean what you might call a piston that was truly cylindrical? A. Well, I couldn't say that positively.

Q. Well, at any-rate the improvement he was trying to make in them was through the composition, as you understood? A. Well, I don't know that, either, positively because I wasn't very much interested at that time. It was a newer development of pistons.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

Both you (indicating Mr. Bruninga) and Mr. Sutherland talked to me today before I came on the witness stand. I came into your room at the hotel about 9:30.

Q. And when Sutherland and I talked to you about the piston, what were we trying to do,—find out something or tell you something?

Mr. Richey: I think that is objectionable: asking for the witness' conclusion.

A. Well, you asked me questions.

(Narrative continued) You did not make any statements as to what you wanted me to do when I got on the witness stand with reference to testifying. You told me not to try to testify on those points I wasn't clear on, that I wasn't expected—that was too far back; I couldn't recall all of those things. Neither you nor Mr. Sutherland showed me any pictures or pistons.

I have no interest whatever in this case; I don't know yet what it is about.

You (indicating Mr. Bruninga) asked me to come here, and you said you were willing to pay my expenses. You did not promise me anything at all.

I just moved my factory into Chicago from Rockford, Illinois. I make airplane propeller type, aluminum casting fans; it is not like an ordinary electric fan; it has blades that look like an airplane propeller, four blades.

Piston inserters was the name of one of the tools Mr. Monckmeier was manufacturing at the time I sold some of his tools. These were used for inserting a piston into the cylinder block, motor block. Another one was a ring inserter for getting the rings onto the piston.

I don't recall that there were any accidents at that Iowa City race. Outside of the young man whose pic-

ture is in that exhibit, I remember another man in that race by the name of Sig Haugeahl.

I think that race was around Labor Day, 1914.

Previous to 1914 I had been in Chicago, Illinois mostly. I was selling advertising at that time more than anything; there weren't so many automobile races that year. I quit race promoting in the fall of 1915.

I saw these pistons of Monckmeier in the fall of 1914, before I went into the automobile business and quit the racing business. I saw those pistons before the Anamosa race in 1915.

I don't remember how long ago I was asked for that affidavit. I think it was about ten years ago or so. Mr. Monckmeier was not a very talkative fellow in 1914 and 1915.

The smoking of Mr. Monckmeier's engine did not continue throughout the race; it quit after his motor warmed up all right. Apparently it depended on how much it would run up or how long he had to wait before the race actually started, and some times before he was going around on the half-mile track; it would quit that excessive smoking; nothing definite about the exact time.

When I saw those pistons in that garage in Iowa City in 1914, I first thought of those holes; then I picked it up and saw that concave head. I had never seen anything like that, so I wanted to know why. I mean the round holes; they all struck my first glance, of course. I also had never seen anything like the T-slots, and I asked him why he did that.

When I saw those pistons in 1914 at Iowa City, like Exhibit 3-W, they were all in good condition then to put in the motor, and one side was not smashed like in 3-W now.

Mr. Bruninga: That is all.

RE-CROSS EXAMINATION by Mr. Richey.

The smoke I saw come out of that car was blue smoke, I guess. The cause of that blue smoke would be excessive burning of oil that is pumped into the cylinders by the pistons. When that car was running, that smoke would spread over considerable territory as against when it was standing still.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

Of course if the car was to stand after he got going while his motor warmed up, his smoking would not be as excessive as it was before he probably warmed up his motor, apparently. As I say, after he got going fast, that smoke would be distributed over more territory; it wouldn't be quite as noticeable. It was very little different than any other of the racing cars after he had gone a few laps. They all smoke some, all cars, even after they have gone a few laps. After he was going awhile, I don't think he was any different than the most of them; their complaint was at the first.

Mr. Bruninga: That is all.

(At this point testimony of PERFLER, Record pages 275 to 292, was taken.)

WILLIAM M. VENNER, a witness of lawful age, being duly produced, sworn and examined, testified in behalf of defendants, as follows:

DIRECT EXAMINATION by Mr. Bruninga.

My name is William M. Venner. I am forty years old, and reside at 5631 Pershing Avenue, St. Louis, Missouri. I am employed as salesman by the Furnace Oil Corporation, selling Kendall motor oil.

I went through grammar school; had two years in high school and two years in the Syracuse Technical School, of Syracuse, New York, at night. After I left school I went to work for the H. H. Franklin Manufacturing Company, Syracuse, New York, in October, 1907. I was with the Franklin Company until December 30th, 1915. After I left them, I went to South Bend, Indiana, and with some other parties opened a Franklin agency on January 1st, 1916. I was in South Bend, Indiana, until May, 1920, when I came to St. Louis and took over the Franklin agency, with two other partners. I had the Franklin agency here a little over ten years, and after that we were still in the automobile business, up to December of last year, handling other makes of cars.

At the Franklin Company I started as a stock room boy and helper in the engine assembly. Then I got to be helper, assembling motors; then I got to be a full-fledged motor assembler, and then I worked in the repair shop

part of the time; worked in the test shed part of the time, testing, in the experimental room; had charge of the motor noise department; charge of the experimental laboratory, for a time, and then I was on the road, approximately, for three years, for the service, engineering the sales department.

I know Elmer C. Long, and first met him at the Franklin Factory, Syracuse, New York, the latter part of March, 1916. I was married on April 8th, 1916, and it was shortly before I was married that I saw him there. I came back from South Bend, Indiana, where I was located at that time, and was in Syracuse either two or three weeks before I was married. I met Mr. Long when I was going into the door, leading to the experimental room, and he was coming out with Mr. Stellman. Mr. Stellman, I believe, had the title at that time of Assistant Chief Engineer of the Franklin factory. His first name is Louis; Louis M. Stellman, and that was at the Franklin factory, in Syracuse. I remember what happened at that first meeting with Mr. Long. He showed me a piston that Mr. Long had gotten up.

Mr. Richey: I object to the part of the answer that says "Mr. Long had gotten up," as being hearsay.

Mr. Bruninga: He showed you a piston, did he?

(Narrative continued) Yes, and I remember what kind of a piston it was. It was an aluminum piston, with six vertical slots in it. The two sections on the opposite sides from the wrist-pins were separated entirely from the head, and were supported from the wrist-pin bosses by two struts. I was familiar with the standard trunk pistons at that time and would describe it briefly as being about the only type of piston I had ever seen up to that time, that was any different than the regular piston which was in use; the skirt was an integral part of the head, without any slots or separation of any kind. This was not the Long piston, but pistons I had seen prior to the time I saw this Long piston.

You (Mr. Bruninga) asked me to prepare a drawing of the piston that I saw and you gave me a drawing of a standard trunk piston and asked me to show in what way the Long piston that I saw differentiated from the standard trunk piston. I have made such a drawing and here it is.

Mr. Bruninga: The drawing is marked for identification, "Defendants' Exhibit A."

The figures No. 1 and No. 2 of this drawing show the standard trunk piston, without any alteration. The figures Nos. 3, 4, 5 and 6 show the Long piston, that I said I saw in March, 1916.

Briefly describing that Long piston, and placing reference numerals on the drawing, designating the various parts, the letter a represents the head of the piston; the parts b represent the ring lands, ring grooves; the parts c represent the wrist-pin bosses; parts d represent four side skirts that are separated entirely from the head; parts e represent the struts holding those sides to the wrist-pin bosses. These struts, e, are not shown in Fig. 5 because the boss is in the way there; they are in back of the boss. They could have been shown by a dotted line.

(Witness places dotted lines on drawing, as requested.)

The part, g, is a truss that was commonly used on lots of trunk pistons and standard trunk pistons at that time. The struts, e, were attached to the wrist-pin bosses as an integral part of the casting, and were attached to the part, d, in the same way. There were two struts in that piston; that is, there were two running from one side of the piston to the other. You might call it four, if you figure from the wrist-pin bosses.

The parts, h, on the drawing represent the slots. They went all the way through the skirt. Part i, represents a slot, and part j, also represents a slot, both of which go all the way through the skirt. The shaded part, k, represents an under-cut portion on the wrist-pin hole sides of the part that was fastened to the head of the piston. An under-cut part like this was found in a great many of the standard trunk pistons.

The standard trunk piston didn't require any bearing surfaces on that K side, and it was merely put there as a relief against expansion. The skirt in the Long piston was connected with the head on the wrist-pin sides, the wrist-pin hole sides.

I examined that Long piston in March 1916.

Q. State whether or not the piston that Mr. Long showed you, and that you saw in March, 1916, was constructed in the manner that you have described, with reference to "Defendants' Exhibit A."

Mr. Richey: I object to that as leading.

A. Yes, sir.

(Narrative continued) When I first came to South Bend, Indiana, the piston then used in the Franklin automobile was made of aluminum, or of aluminum alloy, like Figs. 1 and 2, Exhibit A, but it had four slots in the skirt, extending up about three-quarters from the bottom, three-quarters away from the bottom, to the bottom of the ring land, and it had an oil groove cut all the way around from the top of the skirt to the bottom, about one-quarter of an inch apart; the lands being about a quarter of an inch apart. This piston was like the one shown me, which is marked "Defendants' Exhibit B." It had those slots, as shown in Exhibit B. The purpose of that hole just to one side of the slot was to enable you to put the cotter-pin in the wrist-pin lock screw and to remove it, also. At the time it was first installed the piston used was just like Exhibit B. Later, my men and myself, who were servicing these cars, used to saw the slots up closer to the ring land, groove the lower inside edge of the skirt, and put a steel expansion ring in there. The steel ring came from the factory. We put the steel rings in, in the latter part of 1916, or the early part of 1920—sometime between those dates. A piston of the character of Exhibit B, with a steel ring, was used until the latter part of 1920. After that the Long type piston described in Figs. 3, 4, 5 and 6 (indicating) in Exhibit A was used. The Long type piston was furnished by the Service Department about April, 1920, and they were put in regular production about November, 1920. I can fix that date of April, 1920, when the Service Department put them in, because I got up the service bulletins we had, with the exact dates on them. I recognize Service Department bulletin, sheet No. 262, composed of two sheets. It is a bulletin containing information of interest to dealers, and contains an article referring to the Long type piston.

Mr. Richey: I object to any interpretation of contents of the document, by the witness, as hearsay. As to anything it says, the document itself is the best evidence, if it is relied upon as a disclosure.

By Mr. Brunings: The two pages of Service Department Bulletin, sheet No. 262, are marked for identification as "Defendants' Exhibit C."

The second page of this sheet bears the date of April 8, 1920. That sheet was received and read by me at that time.

Q. The second page of that sheet bears this notation: "LONG TYPE PISTONS. After April 15 the Service Department will be able to furnish Long Type Pistons in standard size. These are straight pistons with two or three thousandths clearance. Their weight is approximately the same as the standard pistons." Do you know whether the Service Department furnished those pistons after that date; after that date of April 8, 1920?

By Mr. Richey: That question is objected to as leading.

A. Yes, sir, (continuing narrative) immediately after; as soon as you could get your order into the factory they were available. We obtained some because we were very hungry for pistons of that type, and ordered them immediately, because we had so much trouble with the one that was in production at that time—Exhibit B. The make-up of those Long pistons that we were furnished then were the same as this Exhibit A here, in 3, 4, 5 and 6.

Exhibit C, which you obtained from me is one of my possessions. I kept a binder full of those bulletins, and I took that from my original binder. It was one of the originals that I received.

These two sheets of paper Service Department Bulletin, sheet No. 289, marked as Defendants' Exhibit D were obtained from me, and have been in my possession ever since I received it.

Q. This sheet, Exhibit D, bears the date of November 11, 1920: Did you receive this sheet before or after that date?

By Mr. Richey: I object to that as leading, and as asking the witness to testify to the contents of a document, which, if its date is material, is the best evidence of itself.

A. I received it a day or two after that date, probably.

By Mr. Bruninga:

Q. This sheet contains the following sentence: "All motors going through production at this time are being

fitted with this new piston known as the Long Piston and a more quiet motor with slightly increased ability is the result." Can you tell me from your own recollection whether at that time, or thereafter, Franklin automobiles were received by you having a Long piston?

By Mr. Richey: I object to counsel testifying as to the contents of an alleged bulletin, and object to the question as leading and improper; that the recollection of the witness has not been exhausted, and there is no occasion for producing the bulletin.

A. They were received by me about November, 1920.

By Mr. Bruninga:

Q. Can you fix the date at all, by the date of this Exhibit D, when the first pistons were received in Franklin automobiles, the Long pistons? A. Yes, sir. May I look at this (indicating Exhibit D)?

By Mr. Richey: Let the record show that the witness examines the paper, marked for identification as "Defendants' Exhibit D."

A. They were in production at that time, at the time that bulletin was printed.

By Mr. Richey: I object to the answer, as it has not been shown that he was in a position to know when the pistons were put in production.

By Mr. Bruninga:

Q. How were you in a position to know when the pistons were put in production at that time? A. Because we always received notification from the factory when the changes were made, and we could also tell by listening to the motor run, whether it had them in or not.

By Mr. Richey: The first part of the answer, based upon notification, is objected to as hearsay.

By Mr. Bruninga:

Q. Did you have occasion to tear down, or take down, any motor to examine whether they had Long pistons, at that time?

(Narrative continued) Yes, sir. Within a very few weeks after we received that bulletin we had one Long piston score, and had to remove it and replace it with

another one. That Franklin automobile had a Long type piston in it. There are so many things that we have to cause it, that it is hard to say what caused the scoring. The other pistons were all right. This happened while I was in St. Louis. The construction of those Long pistons in the automobile we had to tear down, was the same as Exhibit A, Figs. 3, 4, 5 and 6.

(Mr. Bruninga places before witness three pistons, marked for identification as "Defendants' Exhibits E, F and G.")

I recognize all of these pistons. F is the same type of piston that Mr. Long showed me in 1916.

Q. Can you tell me whether or not it is the same construction?

By Mr. Richey: That is objected to as leading.

A. Well, that is what my answer to the previous question was intended to be, that it was of the same construction that he showed me at that time.

By Mr. Bruninga:

Q. Do you know whether it had the groove underneath the lowest ring land all the way around?

(Narrative continued) I don't think that it did. I think the groove merely extended to the portion that is fastened to the head, like that shown in Exhibit A, Figs. 3, 4, 5 and 6. I used some Long pistons in automobiles before April, 1920, which, as I said, is the date I received Exhibit C. I think I received some of them from Mr. E. C. Long, and I am positive the major portion of them from M. K. Weems of Quincy, Illinois. I am quite certain I received some from Long, himself, in 1918; no, that is wrong—it was in 1917, because it was while the Franklin were using the pistons marked Exhibit B, here. Exhibit B was used in Franklin cars up to 1920. We received the first cars, with Exhibit B pistons in them, approximately in November, 1916, and shortly after that time, due to the amount of trouble we had with them, I started buying the Long pistons. I knew where to get them because I had already seen them at the factory, in 1916, and I don't know how the information came to me. Mr. Long was a Franklin dealer at that time, and I presume that is how I knew where to get them. I

kne. he was a Franklin dealer, at that time, because, being on the road for the Company, I had a list of all the dealers.

The construction of the first Long pistons, that were furnished by Mr. Long, was practically identical with Exhibit F (indicating piston). It differentiated from it in that the little groove didn't extend into the portion fastening the wrist-pin bosses in the head. This is the groove in Exhibit F, which is just below the ring land, and it ran like in Exhibit A, Figs. 3, 4, 5 and 6. The first pistons were sand cast and had one rib on the inside of the head. I bought several dozen pistons from Long, before the Service Department began to furnish the Long piston. I bought some while I was still in South Bend, and they were constructed like "Defendants' Exhibit F." After I came to St. Louis I bought some pistons, and they were like Exhibit G, die cast. These were bought from the Franklin factory and from M. K. Weems, of Quincy. The Franklin factory was putting out pistons like Exhibit E, then. Exhibit D is also a piston the Franklin factory furnished.

(Here ensued colloquy among counsel concerning the identification of pistons indicated by the witness.)

(Witness' narrative continued) The proper answer to those questions is that Exhibit G was purchased from the Franklin factory, and Exhibit E from M. K. Weems, of Quincy.

By Mr. Richey (to the witness): You do not mean those identical pistons; you mean pistons like those?

By the Witness: The same construction.

By Mr. Bruninga:

Q. Did the first pistons that you bought from the Franklin factory have the oil holes and the groove just above the number 32313, in Exhibit G?

By Mr. Richey: That is objected to as leading.

A. No, sir.

By Mr. Bruninga:

Q. Do you know whether those grooves and oil holes were ever in the Franklin pistons? A. They were in the later ones.

By Mr. Richey (to the witness): He asked whether you know. You can say yes or no. I object to the answer as volunteering something.

(Narrative continued) I do not know the number of pistons, of the construction of Exhibit E, that were purchased from Weems, but there were dozens of them, during 1920, 1921, 1922. I bought a considerable number from Weems, while I was in St. Louis, and started buying from Weems immediately after I came to St. Louis, pistons like Exhibit E. I stopped handling the Franklin, in St. Louis, during the year 1929; I don't recall the month. In 1930 we ceased to handle the Franklin, and I gave up the agency. The Franklin automobile as furnished to dealers, particularly myself, continued to use the Long piston from about November, 1920, until about the early part of 1928. Then they used the Invar strut piston. I don't know what company furnished the Invar strut piston. During the time I used them, the Long pistons gave excellent service; much better than anything we ever had before. With the pistons, B, there was probably slapping when you received the automobile from the factory. With the Long piston, you seldom got a slap in that until you had from thirty to thirty-five thousand miles. This I know from experience, and it was true with the first Long pistons I obtained. Back in 1917, 1918, 1919 and 1920, I knew of no other piston that would give that service.

No piston was ever offered to me by the Aluminum Company of America, that would give that service, during those years. I never tested any pistons bought from the Aluminum Company of America, during the years 1917, 1918, 1919, 1920 and 1921.

No pistons were offered me by the Cleveland Trust Company of Cleveland, during the years 1917, 1918, 1919, 1920 and 1921. I have never heard of Edward J. Gulick, of Elkhart, Indiana. Elkhart is eighteen miles from South Bend. Mr. Gulick never offered me any pistons.

During the years 1917, 1918, 1919, 1920, 1921 and 1922, there was a great demand for a piston that would perform the service that the Long piston did, but I did not find anybody except Long that furnished it.

This bulletin, Franklin Service Bulletin No. 348, which is marked for identification as "Defendants' Exhibit H," which I previously gave you, was received by me in the mail, from the Franklin factory. It has been in my possession since April, 1922.

This bulletin, Franklin Service Bulletin No. 369, dated February 20, 1923, two sheets, marked for identification as "Defendants' Exhibit I," which I also previously gave you, has been in my possession since February, 1923. The Franklin Company was furnishing pistons of the construction shown in the first page of bulletin, Exhibit I, at the time I received this bulletin.

Mr. Bruninga: I offer in evidence "Defendants' Exhibits A, B, C, D, E, F, G, H and I."

By Mr. Richey: We object to the alleged bulletins, Exhibits C, D, H, and I, as incompetent and immaterial; and object to the statements therein as hearsay.

(Narrative continued) I am acquainted with George J. Oltsch, Patent Attorney, of South Bend, Indiana, and had business with him in April, 1920, while I was still in South Bend. He applied for a patent for me, on a split skirt piston.

Q. I hand you a certified copy of petition, specification, oath and drawing, as originally filed, in the matter of a forfeited and abandoned application of William M. Venner, filed April 12, 1920, Serial Number 373,340, marked for identification as "Defendants' Exhibit J": Will you examine it and state if you are the Venner named in that application?

By Mr. Richey: That is objected to as immaterial and as not related to any defense in the answer. I do not think it has been set up in the answer.

By Mr. Bruninga: Mr. Richey, you will find a defense in the answer, as far as that matter is concerned.

By Mr. Richey: Which one of the defenses is it?

By Mr. Bruninga: Two of the defenses are enumerated in paragraphs 40 and 41 of the answer.

(Last previous question read to the witness.)

(Narrative continued) Yes, I am the Venner named, and I filed the application. I recognize the sheet you have handed me, containing three views, in pencil, and containing on the back the word "piston" (marked for identification as "Defendants' Exhibit K"), as a drawing of the piston that I filed the application for a patent on. The sketch was one I made on February 16, 1920, the date noted thereon. I made some pistons constructed as illustrated in Exhibits J and K before February 16, 1920, the

date noted on the sketch, Exhibit K. The patterns were made by the Peerless Pattern Company, of South Bend, Indiana, and the castings were made in Cleveland, by the Aluminum Company of America, before the date of Exhibit K. When I received the castings I machined up about fifteen of them and put some of them in Franklin automobiles, at South Bend. After they were machined up, their construction was just like Exhibits J and K, and they were given a trial for several thousand miles of use. Their operation was fairly satisfactory. I didn't have any particular trouble with them, but in the first ones the webs extending from the head hole to the skirt portion were too light. I did nothing to remedy that, and in some of them the webs would collapse slightly. The web was between three-sixteenths and a quarter of an inch in thickness, made of lynite, an aluminum alloy.

That was the material that the Aluminum Company of America made the pistons out of. I specified in my order that they would be made out of Lynite, an aluminum alloy. The pistons were made in Cleveland, Ohio. I did not go any further with the piston because at the time I got it up I thought it would be better than the Long type, but it was not any better, so I just quit. I thought the Long was really better than what I had. The purpose of splitting the skirt of Exhibit B was to allow for the inherent expansion of the aluminum. This was not necessary with cast iron pistons, but it is necessary to split the skirt in an aluminum piston because the aluminum expands approximately three times as much as cast iron does, under heat. I knew this in 1916, and I also knew when that splitting would accomplish that, in the aluminum skirt. From my experience in this art, if I had any particular piston out of cast iron, and I wanted to make it out of aluminum, I would slot the skirt in order to have it function in a cylinder without sticking. I would say it was an obvious thing to do. I was familiar with piston rings in 1916, and they were split at that time. If I were given a piston of aluminum I would split it immediately under the head and down the sides, if it were possible to do it with the particular casting, and between the wrist-pin bearing.

"Defendants' Exhibit L," dated September 22, 1920, is a copy of a letter I received from George J. Oltch, and I have a distinct recollection of receiving the original of that letter. I do not know where the original is now. I was in St. Louis when I received it.

By Mr. Bruninga: I offer in evidence "Defendants' Exhibits J, K and L."

By Mr. Richey: I object to all of them as not relating to any defense set up in the answer, and as immaterial as far as the Gulick patent is concerned, because they were subsequent to his filing date.

I object to the letter as incompetent, and to the statements in the letter as hearsay, and not sworn to, and the author is not produced for cross examination; further, the letter is not properly identified.

CROSS EXAMINATION by Mr. Richey.

Aluminum or aluminum alloy is also lighter than iron—a couple of times lighter; it is also a better conductor of heat than iron, and conducts heat away from the explosion chamber faster than iron. I knew, a good many years prior to 1920, that aluminum possessed these properties, and that aluminum expanded about three times as fast as iron.

The Franklin car has always been an air-cooled car, and though I can't give you the exact date, since the Holmes car ceased to be in existence it has been the only air-cooled car in the country, and that has been a great many years. By "air-cooled" I mean the motor is air-cooled as distinguished from water-cooled.

Cast iron pistons had been used in the Franklin car before they adopted aluminum pistons. The main reason they changed from cast iron to aluminum pistons was because it cooled the motor better; the motor cooled better with the aluminum pistons; also, for the extreme light weight of them. It was desirable because an air-cooled motor naturally ran much hotter than the water-cooled. It was desirable to conduct the heat away more rapidly because we had trouble at times with the iron pistons scoring from the heat. That scoring did not take place until after the engine had been heated, because, with the iron piston they became so hot that it was impossible to lubricate them at high temperatures. It was possible to lubricate the aluminum pistons at the higher temperature because the motor ran much cooler with them in there. It did not reach the high temperature as it did with the iron. We didn't have any great amount of this trouble. The aluminum piston was not put in there entirely on account of heat. The Franklin Company had been having this trouble with the iron pistons before they adopted the aluminum piston, for about two or three years.

Another reason for adopting the aluminum piston in place of the iron piston was to obtain lightness of reciprocating parts; to reduce vibration and quicken acceleration. There were no other reasons that I know of for substituting the aluminum piston for the iron piston. This Exhibit B was the first aluminum piston that was adopted by the Franklin Company, to my knowledge.

I don't know from actual experience whether or not some of the other companies tried to use trunk type aluminum pistons.

I did not see a trunk type aluminum piston as far back as at the time I saw the Long piston. I never saw any in the Marmon cars in the early days.

This Exhibit B piston succeeded the cast iron piston in the Franklin car, but I don't think the first few of them had those four slots in. I think they were in the solid skirt. They used this "trunk type" piston, with the solid skirt, only a very short time, then they went to this Exhibit B. They made this change so that they could fit the skirt a little closer, and it would not stick. They didn't have any trouble with the trunk type aluminum piston sticking in the cylinder, but they had trouble with them slapping.

When the first Exhibit B pistons were used, they did not have this ring on the inside, that I spoke of. They were used without that ring for a few months. The ones with the slot still slapped and we put the ring in to squeeze them out, so they would have more flexibility. They were used just a few months with the rings in, then they changed to the Long type. That change was made because the Long type piston was so constructed that they could be fitted very close and they wouldn't seize when they were hot.

We had no trouble with Exhibit B because of the ring seizing, but we had trouble with them slapping.

I believe other automobile manufacturers besides Franklin Company used pistons like Exhibits E, F, and G after 1920, but I don't recall who they were. I don't know of my own knowledge.

The Invar strut piston was substituted for the Long piston in about 1928. That Invar strut piston was a piston that had a slot extending from the bottom ring land to the bottom edge of the skirt of the piston, on one side of it, and there are two steel struts mounted in practically the same position as the Long piston, extend-

ing from side to side. That is all I remember about it, with the exception that there was a skirt slotted underneath the bottom ring groove, on both sides, underneath the head. There was only one slot running the full length of the skirt. I have seen a large number of those pistons between 1928 and the present time.

I saw more pistons like Exhibits F and G, between 1920 and 1928, then I have seen of the Invar strut.

I have attended sales conventions, at Syracuse, where the Franklin dealers assembled. I don't recall of attending any sales conventions at Syracuse while I was in South Bend; I did some, at Chicago, that they would have at show time there, and I attended some at Syracuse during the time I have been in St. Louis. I don't think I ever attended any other kind of conventions or meetings at Syracuse, while I was at South Bend. I attended probably five or six while I was at St. Louis. I think the date of the earliest one was about 1923.

I frequently went to Syracuse on visits, sometimes twice a month, and sometimes two or three months apart, while I was at South Bend and also while I was at St. Louis. When we were in South Bend we used to drive back most of our cars, and I went to the plant at Syracuse a lot for that purpose; and, it was my home and my folks' home, so I visited there while I was there. I don't believe I was ever in Syracuse that I didn't go up to the Franklin plant. These visits to the Franklin plant have extended from 1916 to date. I was there just a few weeks ago.

I was at the Franklin plant in Syracuse last September and Mr. Caster was just packing his tools up to leave; he had been laid off; in fact, they closed the whole drafting room. I don't know whether he is back again, or not. There was considerable activity there in the drafting room two weeks ago, when I was there. I didn't go in; I just stuck my nose in the door. I knew Mr. Caster there over a period of years. I also knew Mr. Marks; he is still there. I have known him ever since he went there to work, whenever that was. I don't know just how long ago that was; a good many years ago.

The first actual work I did when I went to the Franklin factory was drilling holes in little quarter-inch cap screws—I beg your pardon; that was not the first work I did; I helped to assemble motors very shortly after I went there. I would say that was around 1909, or the early part of 1909. I helped to assemble motors, I think,

not over six months; then I was head assembler, with a helper of my own. I worked at that a couple of years; that carried me up to about 1911; I don't remember the exact month. I am pretty certain that it was around 1911, because I left there for six months and went to work for the Fiat Company, in 1911, and went back. I left the Franklin Company in March or April to go to the Fiat Company, and it was somewhere between four or six months later that I came back. I was several months with the Fiat Company in Poughkeepsie, N. Y.

I assembled motors after I came back to the Franklin plant, and I continued in that work for the remainder of the year. I next was inspector, for a few months, of the engine assembly. Then I took charge of the motor noise test department; that was about the first part of 1912; and I continued in that department until somewhere along in August of 1912. Then I went to work for the engineering department, in the experimental laboratory. I stayed there until the early part of 1913. I don't remember what month of 1913; I could tell from records I have. My next job was to go on the road for the Service Department in the early part of 1913. I was mixed up with that job—I did a little work for the engineering department and the sales department for practically the next three years, returning to the factory occasionally, for possibly a month or two.

Mr. Stellman was present when I had that conversation with Mr. Long about this piston. No one else was present. Mr. Stellman was then employed at the Franklin plant. I usually saw him on these trips that I made to the Franklin plant. He had been my superior there. I always considered him a good friend, and always went to see him every time I was there.

I made this drawing, Exhibit A, this morning. I made it in the next room to Mr. Bruninga's office—in his library at his request.

I started about ten o'clock this morning to make Exhibit A, and completed it twenty or thirty minutes later. I used no drawing instruments and my only equipment was a pen I found laying in the desk, about two inches long, and I used my own pencil and a ruler I found laying there. I brought no equipment with me for making it. At the time I made it I assumed that it might be used in connection with my testimony. I had seen similar pistons like Exhibits E, F and G, elsewhere, prior to the time when Mr. Bruninga asked me to make this draw-

ing. The first time I saw these pistons, E, F and G was when he laid them on the desk there, this afternoon.

The drawing, Exhibit A, is very similar to the drawing of this piston, Exhibit F—practically the same. Except that it is a sand cast instead of a die cast, this Exhibit F was the standard piston of the Franklin Company for a good many years, and I saw it from year to year, between 1920 and 1928.

The conversation with Mr. Long, when Mr. Stelman was present, took place at the Franklin factory, right outside of the door leading into the experimental room, inside the yard. I had a conversation with Mr. Bruninga about my testimony here, several months ago. I didn't know that I would be called as a witness at that time. Mr. Bruninga told me a couple of days ago that I would be called as a witness, and I had a discussion with him at that time, but not about what I was going to testify to. He asked me a lot of questions and I believe he wrote down the answers. I believe it was this morning that he mentioned that I might be interviewed by Mr. McCoy or by you, (Rishey) or by somebody representing the other side. He told me to tell you that I would be glad to answer any question for you, on the witness-stand, if one of you interviewed me. He did not tell me not to answer any questions that you might ask me prior to the time I got on the witness-stand—he said just what I said before—that if you asked any questions, to tell you I would give the answers when I got on the witness-stand. Neither Mr. Long nor Mr. Fletcher ever asked me to testify in any other causes regarding this Long piston. I don't know for how long a period Mr. Long was a Franklin dealer—he was a Franklin dealer a good many years ago. I believe I first knew that Long was a Franklin dealer when I went on the road for the Company, because I had the list of all the dealers, and still have it. I do not know how long he continued to be a Franklin dealer. I did not know him prior to 1916, and never saw him in Quincy—in fact, I never did travel that particular town. Nobody ever asked me to testify in any other cause regarding these pistons, except in this one. I was never told that any other causes existed regarding these pistons, excepting this one.

The bulletins I have been asked about were kept among my personal records. There were a whole stack of them, several inches high. I brought only a few of that whole stack here—four of them. I produced only

four because I picked out the ones that I could find, that referred to this particular piston here. I picked out those four because Mr. Bruninga asked me—I mentioned the fact that it was mentioned in service bulletins, and he asked me if I had any, and I said I would try and find them, which I did.

On November 11, 1920, it was well known that aluminum alloy had distinct advantages as a material for pistons, because it was light in weight and its great ability to throw off heat over cast iron. It was also known at that time that one of the disadvantages to the use of aluminum alloy for pistons was the clearance which was necessary between the pistons and the walls of the cylinders. And at that time it was known that that was due to the fact that the aluminum expands more rapidly than the cast iron. The excessive clearance that was necessary, particularly with the cold motor, had a tendency to make it noisy, to say nothing of affording an opportunity for the escape of gasoline past the rings and into the base, and also allowing an excess amount of oil to work up past the rings; that is correct. That was all known in November, 1920, and prior thereto. This Long type of piston, like those I have been talking about, according to their bulletin there had not proven satisfactory in production, by the Franklin Automobile Company, on April 8th, 1920. To my own knowledge, I don't know anything about it.

There was a time that the Franklin Automobile Company used an oval type piston. That was around 1922, I believe. They used only a very few of them, and to the best of my recollection, it was ground so that the skirt was much smaller in diameter on the wrist-pin hole sides. There was a very small bearing on the opposite side of the wrist pin hole, and it had a sawed slot underneath the bottom ring land, on both sides. I saw some of those pistons, but I don't believe I saw over two or three dozen of them. I believe around April, 1922, they went through production, in small quantities. The results they obtained were so bad that they went back to Long. I dispute the statement in Bulletin H, April 18, 1922, Exhibit H, reading: "A piston which is ground oval in shape and for this reason known as the oval type piston has been going through production in small quantities since last summer. The results being obtained with this piston are so successful that it may be adopted for standard

productions." They may have been of the opinion at the time that it was true, but it didn't work out that way. According to my experience, it is not a true statement. I don't see why the experience of the people who prepared this bulletin, Exhibit H, would be any different than ours. It may have been a true opinion on their part, but I don't think it was a correct one. I knew from the experience that we had with them in cars, that they were not satisfactory. I don't know whether the statement is true or not. I don't know why they were experimenting with this oval type piston down at the Franklin factory.

Piston slap is a noise caused by the striking of the piston wall against the cylinder wall, and a ping is the detonation of the gasoline in the combustion chamber.

The instructions contained in this Exhibit I, Franklin Service Bulletin, dated February 20, 1933, which shows cuts, relate to the piston illustrated on the initial page and at the top of the second page.

I will bring with me tomorrow the balance of these bulletins, from which I selected these four that have been offered in evidence here.

When one of the first Long pistons that we used scored, we substituted another one for it, in St. Louis. It had been in the cylinder a very short time—a few weeks—before we made the substitution. We found, upon removing the first piston, that there was a tearing of the metal and on the two faces that bore on the cylinder wall, on the thrust face, which was due to its rubbing against the iron cylinder. That piston came in the first Franklin car that was received by us equipped with Long pistons. That car ran seven or eight hundred miles before it scored. That was in the early part of December, 1930, I believe. I don't remember where the substitute piston came from, because we probably had pistons from Franklin and from Weema in stock at that time.

We first dealt with E. C. Long for the Long pistons, and then I think it was M. K. Weema. I don't think we had any correspondence with them, other than sending them an order and receiving a bill for it. In fact, I think they were sent C.O.D. at that time. I think the only thing I did was to write them a letter and tell them to send me so-and-so. I don't remember whether they sent a bill, or sent it C.O.D.

We bought several dozen pistons from Weema. That would probably be a dozen shipments or more. I don't

remember whether they were sent C.O.D., or were the regular transaction. We would probably have records of the transaction at that time. Those records are destroyed. The company has been out of business a good many years. I kept these bulletins because they were of value to me and the other records were not. I kept the bulletins but I didn't keep the other records. I cannot say whether any one of these shipments were C.O.D. or on a regular transaction. I don't remember exactly how many shipments there were. I don't remember when the last shipment was received; that was a good many years ago. I ordered them so many different places; sometimes from the factory, and sometimes from Weems, and I don't remember which was which. I don't remember when we ordered or received the last shipment from Weems; that is not too far back to remember, but I just don't remember; I had no occasion to try to remember it.

The Franklin Company did not, to my knowledge, try out any other pistons than the oval type pistons and the Invar strut piston, between the time the so-called Long piston was adopted by them, and the time it was abandoned.

I was in South Bend, Indiana when I made this sketch, Exhibit K; I don't remember whether I made it at the office or at home. I had a model before me when I made that drawing, because the one I made previous to that I had the patterns made from. I made that one for the patent attorney to apply for the patent with. I turned it over to my patent attorney the early part of April, 1920, or it might have been a little sooner than that. I don't recall the exact date. To be more exact, I imagine it was probably the early part of March when I took it up to him. It must have been some time between the time I made it and the time he filed those papers. I have no recollection, independent of these dates on the sketch and the application, when I did deliver it to him. I not only fix it by these dates, but I can also fix it by the fact that it was shortly prior to the time I came to St. Louis.

I said these castings were made by the Aluminum Company of America, but it might have been the Aluminum Castings Company; it was the company that made Lynite, the people who have the trade name Lynite. I don't remember the name. It was not the Aluminum Manufacturers, Inc., and it was not the U. S. Aluminum Company.

We had correspondence with the company that made our castings, about those castings. I don't think they made blueprints or drawings of the castings—I sent them the molds which we had made by The Peerless Pattern Company, South Bend, Indiana; I should not have said the molds; I meant the patterns. I presume the company in Cleveland, that made the pistons, made the molds.

I don't recall exactly how much we paid them for the castings, but I believe it was around \$2.95 apiece, and that included the molds; they were charging for the finished product that they turned over to me. I think I bought about two dozen castings from them, two or two and one-half dozen. I imagine I paid them from seventy-two dollars to one hundred dollars. My recollection of the price is not accurate. I don't remember how much I paid them; it seems to me that it was sixty or seventy dollars, although I don't recall.

The purpose of my piston was not to accomplish the same thing as the Long piston; I thought I had an improvement on his, but I found out I didn't. I was undertaking to improve upon the Long piston. I thought that by suspending those independent skirts from the head, that the expansion would take place downward, but I found out I was mistaken about it. I wanted the expansion to take place downward so as to obtain less expansion than there was in Long, so that I could fit them much closer. I read over this application, Exhibit J, between the time my attorney prepared it and the time I filed it.

It is true that, as stated in this abandoned application of mine, Exhibit J, one of my objects was as follows: "The invention relates to pistons and has for its object to provide a piston especially adapted for use in air-cooled internal combustion engines, and to provide a piston so constructed, that the use of aluminum and other light metals may be accomplished, thereby giving lightness of reciprocating parts, which metals have a greater relative degree of expansibility than the cylinder casings under the same temperature." That is what I understood the Long piston did. When this application was filed, I was stating to the Patent Office that the purpose of my invention was to do what I understood the Long piston already did, but a little bit better. This statement does not say "a little bit better," but it may further down; I don't know.

Q. This says, "The invention relates to pistons and has for its object to provide" this thing that you knew at that time the Long piston was doing? A. Yes, sir.

Q. Still you were representing to the Patent Office that that was the object of your invention? A. Yes.

Q. The same thing that you say you already knew the Long piston did? A. Yes, sir.

(Narrative continued) I don't know who, on behalf of the Cleveland Company, corresponded with me with respect to these castings, which I said I had made. I don't remember the names of anybody. They wrote me one letter telling me that they would like to hear the results that I obtained, and also mentioned the fact that if it proved out satisfactory, that they might be interested in it; to send them some information about it, or something to that effect. I did not write to them afterwards; I never answered that letter, and never got any more pistons.

(Thereupon, the further taking of the deposition was adjourned until April 28, 1932, at ten o'clock A.M.)

(Met pursuant to adjournment as above, on April 28, 1932, at ten o'clock A.M.)

CROSS EXAMINATION by Mr. Richey (Continued)

XQ. 249. Referring to "Defendants' Exhibit J," your forfeited and abandoned application for your patent, page 3, beginning at line 15, reads as follows: "Pistons of this character in the past, on account of their greater expansibility than the cylinders in which they are used have been found, when subjected to extreme temperature, to bind or seize the bore of the cylinders, and where sufficient clearance has been allowed in the skirt of the piston, under low temperatures, the piston slips." That was a true statement at the time it was made, was it not? A. I didn't write those myself, but I guess I signed it on the end, didn't I?

XQ. 250. You said yesterday that you read it over and signed it? A. Yes, sir.

XQ. 251. The statement I read in the first question this morning, was true? A. It was the true opinion at that time.

XQ. 252. Was it not true in fact? A. I don't know whether it was or not.

XQ. 253. It is not a statement of opinion; it is a statement of fact. In the question I read, that was a true statement of fact at that time, was it not? A. It was my opinion that it was, yes.

XQ. 254. It was your experience, too, that it was true, wasn't it? A. Yes, to some extent.

XQ. 255. Well, how do you want to modify it, if it is incorrect? A. The Long piston, when you allowed three to three and one-half thousandths clearance didn't do the things it said in there; however, with smaller clearance, it did.

(Narrative continued) This statement I made applied to the Long piston, under certain conditions. When that statement was made, I knew about the Long piston.

XQ. 258. And still you did not modify the statement to except the Long piston? A. It doesn't say, in that, all pistons; it says pistons of this character, doesn't it?

XQ. 259. Yes, but by "pistons of this character" you meant of the character shown in the application, did you not? A. Aluminum pistons as a whole, I presume.

(Narrative continued) The Long piston was an aluminum piston. When I made that statement there, I claimed to have had the Long piston and the others that were used in mind, and to have known about it. I did not except the Long piston, in the statement, because I thought that one would run with much closer clearance than Long. I intended to include the Long piston in that statement at the time I made it.

The clearance allowed for the Long piston was from three to three and one-half thousandths.

The advantage of having a narrow clearance between the cylinder and the piston, is that there is apt to be less oil pumping; it allows the ring face to stay flat against the cylinder wall. It will give greater ring life and longer life between replacements. The disadvantage of the oil pumping is that it uses oil and fouls spark plugs and causes frequent valve grinding, and carbon accumulation. It pumps oil into the combustion chamber. The disadvantage of the effect on the piston rings of the large clearance, is that it allows them to rock and become sort of circular on the face, instead of flat. It would probably wear the edges of the piston ring grooves faster and, in addition to that, cause a slap.

Referring to the Invar strut piston, which I spoke of yesterday, the clearance on that, as I recall, is three

and one-quarter to four thousandths. The clearance there was about the same as the Long piston. The Invar strut piston was used in other engines besides the Franklin engines; in a great many other automobiles. I do not know that it was fitted to less clearance with other automobiles, than three and one-half to four thousandths.

XQ. 277. There was also an aluminum piston known as the split skirt piston, that had no Invar strut in it, that was used quite generally prior to the Invar strut, was there not? A. Well, the only one that I saw, the split didn't extend clear to the top of the skirt. There was a little hole drilled in, and it extended almost to the top. I believe the piston was made by the Aluminum Company of America.

(Narrative continued) I am familiar with the split skirt piston that had a recess at the boss and webs across—that is the one I am referring to. Those pistons were quite generally used, beginning about 1924 or 1925, and I believe they are still in use, though I am not sure.

I was married on April 8th, 1916, and left Syracuse on a wedding trip right after the wedding. I spent the first night in Buffalo; the second night in Williamsport, Pennsylvania; the third and fourth nights in Chicago, and the next day in South Bend—about five days in all. I was in Syracuse two weeks, I believe, or a little over two weeks before I was married. That is, I went down and stayed two weeks before I was married, and then spent five days on my wedding trip.

I said I made this drawing, Exhibit A, yesterday, here in this office. I drew those red lines in there, not the whole thing, just the red ones. Yesterday, when you asked me if I made this drawing, I didn't intend to say that I made the whole drawing—I didn't make the whole drawing. It is not a drawing; it is a photostatic copy. Mr. Bruninga gave that photostat to me; everything in black, except these reference numerals, was on here when I started on it, and when he handed it to me. I put the letters and shaded portion on there, and the little dotted section of the web, shown on Fig. 5; that is all I did. Yesterday, when you asked me about it, I did not make that distinction. It would be quite obvious to you that I didn't make the photostat.

I don't know how much there was to that application, Exhibit J.

After I got here in St. Louis I decided not to proceed with this application; in fact, I believe it was just

about the time I left South Bend, in May, 1920. At that time I learned that the Long piston was a good piston.

I never instructed my attorney not to proceed with the application; I just ignored his letters.

Mr. Richey: I should like it to appear that there was an amendment filed in this application, by the attorney, November 26, 1920, which was responsive to the Office action of September 20, 1920, and that that is the one that was referred to in Exhibit L; and further, that there was an interference letter of February 15, 1921, sent to the attorney, and under the practice, one would also have been sent to Mr. Venner.

(Narrative continued) I would say that I received those first Long pistons from M. K. Weems, Quincy, Illinois, during the middle of 1920; however, I am not certain about it. It was not many months after the Series 9-A came out.

The pistons illustrated in my application, Exhibit J, were not any better than Long's. It is correct that the tests were made before the date of this sketch, Exhibit K, which is February 16, 1920.

XQ. 311. Then, why did you file your application on April 12, 1920, if the tests had already shown you that the pistons were not as good as Long's? A. The tests were not completed at that time; they were in cars, running, but I didn't discover it until there was some considerable mileage on it.

(Narrative continued) It is correct that I did not complete these tests until after the application was filed. I did have them in cars before February 16, 1920. The first one I put in just one, just one piston. It was very satisfactory. Then I put in, I believe, a couple of sets more, or a full set, I don't recall which, and those were in the car at the time the application was filed. I did say yesterday that I made some of the tests before February 16, 1920; they were partially made. One of the tests was completed before that date, but the other was not. The first test was of but one piston.

I believe this Series 9-A car came out in November of 1916.

There was an advertising campaign about the first part of 1920, trying to stimulate a demand for cast iron pistons. I believe the use of such pistons in Franklin

cars was discouraged by the Franklin Company. The purpose of these special design pistons was to reduce the weight of an iron piston.

RE-DIRECT EXAMINATION by Mr. Bruninga.

RD. 1. Referring to "Defendants' Exhibit A": What do Figs. 1 and 2 illustrate?

Mr. Richey: We object to that; he has already testified about that.

A. It illustrates the old style plain trunk piston.

By Mr. Bruninga:

RD. 2. Yesterday, Mr. Richey intimated that these figures might have been made from a Franklin piston; do you know whether they were? A. This drawing, Exhibit A?

RD. 3. Yes; the drawing that was handed to you. A. No. That piston, a piston like that, was never used in a Franklin.

Mr. Richey: That is, like shown in Exhibit A?

Mr. Bruninga: That is, like shown in Exhibit A.

The Witness: In all the details, yes.

RD. 4. What do you mean, Figs. 1 and 2, or the rest? A. One and two.

(Narrative continued) My attention has been called to page 149 of The Gasoline Automobile, its Design and Construction, Volume 1, The Gasoline Motor, by P. M. Heldt, Editor of the Horseless Age Co., 250 West 54th Street, New York, 1915. Comparing that piston, illustrated on page 149, with Figs. 1 and 2, so far as general structure is concerned, I would say it was identical, with the exception that the one on page 149 has four ring grooves, and Figs. 1 and 2, on Exhibit A, have three ring grooves. Figures 3, 4, 5 and 6, as I have drawn them, are distinguished from that particular piston on page 149, of the book, in that the piston on page 149 is a solid skirt piston, the skirt being an integral part of the head. Figs. 3, 4, 5 and 6 show the skirt as being in six sections, four of which are supported by webs from the wrist-pin boss, and being otherwise entirely independent of the head. In other words, Exhibit A was furnished me as a photostat without any red lines or lettering on it, and I added those red lines and also the shading at k, to that piston; also the dotted section, e, on Fig. 5.

RD. 9. And is that the way the Long piston 1916 differentiated from an ordinary trunk piston?

Mr. Richey: I object to the question as not being justified by the record.

A. Yes, sir.

Mr. Bruninga: It is stipulated that the book, "Gasoline Automobile, Volume 1," examined by the witness, was published in 1915, and that a photostat of the drawing on that page may be introduced in evidence with the same force and effect as if the original book were produced.

I offer in evidence the photostat, as "Defendants' Exhibit M."

Mr. Richey: I object to it as immaterial.

Mr. Bruninga:

RD. 10. Mr. Richey asked you with reference to cast iron pistons used by Franklin, during the first part of 1920: Do you remember how those pistons were constructed? A. They didn't use any cast iron, in 1920.

RD. 11. In what year did they use cast iron? A. 1916, was the last year.

Mr. Bruninga: Mr. Richey referred to a digest of the proceedings in the Venner Application, Serial No. 373,340, which I handed to him, this digest being of official actions and proceedings following the filing of the application. I offer in evidence that digest, as "Defendants' Exhibit J-1," together with the original of the official letter of February 15, 1921, and the notice of allowance, dated January 16, 1922.

Mr. Richey: In view of the offer, I withdraw the statement I made about the character of these papers, and suggest that this exhibit be attached to Exhibit J, since they both constitute a part of the same proceedings.

(Narrative continued) Greater expansion takes place in the pistons of an air-cooled motor, as distinguished from those which are water-cooled, up to recent series Franklin, which are much better cooled. By "recent series" I mean from 1930 on.

RD. 14. Would you say that a piston which operated satisfactorily in a Franklin air-cooled engine, had a good test?

Mr. Richey: I object to that as incompetent, being merely the opinion of the witness.

A. Yes, sir.

(Narrative continued) From experience with both air-cooled and water-cooled engines, I would say that the test of a piston in an air-cooled engine is much more rigid.

There was a piston used prior to this Exhibit B here, without the slots in the skirt. It was fitted thirteen thousandths under the bottom ring land; eight thousandths at the bottom of the skirt. Piston B was fitted, I believe, eleven thousandths under the bottom ring land, and five thousandths at the bottom of the skirt. The piston used prior to this Exhibit B piston was a straight trunk aluminum piston, without the split skirt.

The Long pistons were fitted about three thousandths in 1920, the full length of the skirt.

As to the manner in which you and I got in contact, Mr. Sutherland of your (indicating Mr. Bruninga) office, called on me last year sometime, and said that he had been down to the Franklin dealer, and that the man in the stock room told him that I could probably give him some information about it, as he knew that I was familiar with pistons as used in Franklin trades. Sometime later you called me and asked me to come down to your office, which I did. You asked me if I knew anything about the Long piston that the Franklin used, and I said yes, that I had met Mr. Long the first time he ever came to the Franklin factory with this split skirt piston—

Mr. Richey: I object to this conversation as incompetent.

Mr. Bruninga:

RD. 24. Did I ask you for facts, or did I tell you what I wanted you to testify to? A. You asked for facts, and intimated that I didn't know what I was talking about.

RD. 25. Did I give you just a cursory examination or a rigid examination?

Mr. Richey: I object to this whole line of testimony as incompetent and immaterial.

A. A rather rigid examination.

RD. 26. Were you coached at all by me, what to testify to? A. No, sir.

(Narrative continued) The cause of the scoring of pistons is not always the piston construction. Lack of oil and extreme heat can cause it.

In the 1920 Franklin automobiles, the oil was furnished by a pressure system—the pressure feed in the main bearing, through the crank-shaft, and connecting rods, and then thrown up on the cylinder wall. It fed to each individual main bearing, then to each connecting rod, and the throw-off of the connecting rod bearings lubricated the piston and cylinder. In other words, there were separate pipes to each bearing. These pipes lead from a distributor type oil pump, in the bottom of the oil tank case, and was distributed to the various conduits. There was liability of clogging of these conduits, which happened occasionally.

The castings which I testified were made of my pistons, in accordance with the application Serial No. 373,340, were sand cast.

I don't know whether I discussed the Long piston or not with Mr. Oltsch before I filed my application.

RD. 38. At the time that you filed this application, had you found the Long piston not practical?

Mr. Richey: I object to that question as incompetent.

A. No.

RD. 39. Have you ever seen a perfect aluminum piston? A. No, sir.

RD. 40. Referring to the statement on page 2, of "Defendants' Exhibit J," reading as follows: "Pistons of aluminum and alloys on account of their relative greater degrees of expansibility than the cylinder casings, tend to seize the cylinders under high temperature, unless considerable clearance is provided and too much clearance is impracticable." Does that refer only to the Long piston?

Mr. Richey: The question is objected to as leading.

A. No, sir; that referred to the pistons that didn't have a slotted skirt.

RD. 41. Did you so understand it, as referring to that? A. Yes, sir.

Mr. Bruninga: That is all.

RE-CROSS EXAMINATION by Mr. Richey.

The Franklin piston known as the straight skirt piston was the Long type. The 9-B series was the succeeding model, of the 9-A, and was started about 1918. It was used until 1922.

Regarding the journal called "Manual for Trouble Shooters Franklin Automobile Company": The article on pages 8 and 9, on piston slap, dated November 1, 1923, Series 9 and 10 cars is correct, with the exception that they didn't fit that straight skirt piston with as much clearance as they state there. It was nearer three and a half to four thousandths, than it was five. It is stated here to be five. May I ask when the book was published? November 1, 1923? Then I withdraw the statement I made regarding the clearance—that was correct at that particular time.

They commenced fitting these Long pistons with five thousandths clearance when they increased the compression ratio to such an extent that there was a great deal more heat generated, in 1922. They continued to fit them with five thousandths clearance for about a year, then they dropped back to a lower clearance, because they put in a different cooling system.

This same article gives the clearance at the bottom of the skirt of an oval piston, as three thousandths. I believe that was correct for the clearance for those pistons, at that time.

Mr. Bruninga: The book produced by Mr. Richey is marked for identification as "Defendants' Exhibit N."

(Narrative continued) The clearances given here, for the three types of pistons—tapered, straight and oval—were correct at that time. The article deals with piston slap and contains instructions how to detect it and how to cure it. Its statement, "Slaps are due to the clearance allowed between the piston and the cylinder walls," is correct. The statement "Aluminum pistons expand more than cast iron or steel ones, and since this extra expansion requires more clearance, they are more apt to slap," is not, generally speaking, correct. The piston marked "straight," on page 9 of this book referred to, was a Long type piston, like Exhibits E, F and G.

Mr. Richey: That is all.

Mr. Bruninga: Deposition closed.

Mr. Bruninga: I want to offer in evidence "Defendants' Exhibit N."

Mr. Richey: That is objected to, as it is all immaterial, except the part on pages 8 and 9, that are entitled "Piston Slap." The balance of the book refers to other features, steering, position, and things of that kind, not involved in this case.

CHARLES L. CHADWICK, a witness of lawful age, being duly produced, sworn and examined, testified in behalf of defendants, as follows:

DIRECT EXAMINATION by Mr. Bruninga.

My name is Charles L. Chadwick, and I reside in Quincy, Illinois. I am in the machinery business, operating now under the name of Tri-Point Corporation. Formerly we operated under the name The Weems Machine Company, and later, Weems-Chadwick Industries.

I am a tool maker by trade and have made lots of patterns. I also have had experience in automobile repairing. I started to work at the machinist trade for my father, at the age of fourteen, and was with my father for a number of years; and from there, to H. M. Sheer Company of Quincy, where I worked for some four or five years. I was foreman of their shop, and devoted most of my time to tool making. The Sheer Company's line of business was incubator supplies.

Then I left there and worked for the Wabash Railroad Company for several months; then went back with the H. M. Sheer Company; left the H. M. Sheer Company and came to St. Louis and worked for the A. Wister Company; then back to Quincy, in business for myself, for a little while—the machine business; and then went with the H. M. Sheer Company again; and from there to Mr. E. C. Long, in December, 1918.

When I was in the machine business myself, we did a good deal of automobile repair work, in connection with our machine shop. We serviced cars, and placed in new pistons. At that time, most of the pistons that we replaced in cars, we had to make ourselves. That was back between the years of 1910 and 1912. I, myself, made a number of pistons, but most of those were cast iron pistons. I had had very little experience with aluminum pistons before I came to Mr. Long, in December, 1918. Somewhere around the time of 1914, there was an

aluminum installed—I think, in a Haynes car. That was the first aluminum piston that I had seen in an automobile. I made an aluminum piston myself in experimenting, but owing to the poor casting, I never even put it into a car. That was a piston near the standard solid type piston, only it had a little bead on the inside of the skirt, I cut a slot through that bead, or ridge, to take up the expansion. That piston never was installed in a car; I never kept any record or anything of it. That was around '14; somewhere around there. I couldn't tell you any date, but it was before I went back with the H. M. Sheer Company. It was while I was in business myself. We had our shop on Main—or, on Seventh, between Main and Jersey, in Quincy, Illinois.

I have no way of fixing the date that I came to Mr. Long, further than memory. There was a little misunderstanding in regards to salaries, when I went with Mr. Sheer, and so I notified him on the first of December that my resignation would take place the first of January. Mr. Sheer was a man that was easy to upset, and he told me I could quit whenever I got ready. I was working for him on Armistice Day.

Just before the Armistice, Mr. Sheer and I came to an agreement as to an increase in salary, which he was to pay me outside of my regular weekly check, and after the Armistice was signed, I did not receive this extra amount. That was the reason that I left his employ when I did. After Armistice Day, he said that he thought he could be able to get someone to take my place, as the War was over and the boys would all be coming home. I stayed on about two weeks, as near as I remember, in order to finish up some things that I had started, before I left. I went to Mr. Long in the latter part of December; I couldn't mention the date, but I am positive it was before Christmas.

Mr. Long's place was located on Eleventh and Main Streets, Quincy, Illinois. I had had some previous negotiation with him about a job. He came to me sometime in August, and wanted me to go to work for him, but I didn't leave Mr. Sheer at the time. Before I left Mr. Sheer I talked to Mr. Long, and he told me any time I wanted to leave there, why, just to come out and go to work. I quit H. M. Sheer Company on Saturday night and Monday morning I went to work for Mr. Long.

I started as foreman of Mr. Long's shop, and was employed from December, 1918, until November the first,

1919, when Mr. Long sold his business to Mr. M. K. Weems. Mr. Weems died in July, 1930. I stayed in that shop, after Long sold out, and am there yet, in the same shop. After Mr. Weems died, I purchased the business from the Weems estate, personally. It is operated now as a company, as the Tri-Point Corporation. It is a corporation, now. The Company owns the business now, but I bought it personally from Mr. M. K. Weems. Then, in March, 1931, I consolidated with the Tri-Point Corporation. It is operated under the Tri-Point Corporation, now.

There were pistons being manufactured by Mr. Long at the time Weems took over the business—a piston with a slotted skirt; aluminum type, aluminum piston. It originated from an ordinary trunk piston, by putting a rib across from the wrist-pin boss to the side wall of the piston. By putting the ribs across from the wrist-pin boss to the side wall of the piston, it could be slotted with six slots. That was the kind of piston that was being manufactured by Long when Weems took it over, on November 1, 1919.

Mr. Long was making some of those pistons when I went to work for him, in December, 1918. And, as I previously testified, that they were distinguished or differentiated from an ordinary trunk piston by the fact that they had webs and slots in them.

Q. 54. I gave you yesterday a photostat of an ordinary trunk piston and asked you to change it or add to it, in order to produce the piston that you saw when you first came to Mr. Long; can you produce that drawing? Have you made such a drawing? A. Yes, sir (producing drawing). I have this drawing here, which is nothing but an ordinary trunk piston (referring to Figs. 1 and 2).

(Narrative continued) No. 1 shows the one with the wrist-pin. No. 2 shows the piston turned in an opposite way, looking through the wrist-pin hole. No. 3 shows the piston by having slots, two slots, on the side, looking through the wrist-pin hole. No. 4 shows the piston on the opposite side. The line shows three slots. No. 5 shows the interior of the piston, and the red line indicates the rib that is added to the wrist-pin boss and connected with the side wall of the piston. That is to hold those two walls in position after the piston is slotted. No. 6 shows the rib across the other way.

Mr. Bruninga: The drawing produced by the witness is marked for identification, "Defendants' Exhibit O."

(Narrative continued) I put the red lines on the drawing, Exhibit O. Figs. 1 and 2 are views of a standard trunk piston. To my knowledge, such trunk pistons have been in existence ever since I knew of a gasoline engine—back in 1909. It had the cross-web, a, in it at that time. Of course, all iron pistons do not have that. Some pistons are heavy enough to carry that strain, without putting that in. In order to lighten the piston you put a rib on the top of the piston. And those trunk pistons had the wrist-pin bosses, b, and had the ring groove, c,—some had two and some had three grooves.

On Figs. 5 and 6, the parts, d, is an added rib, extending from the inside of the piston wall to the wrist-pin boss. Those were in the Long piston I saw when I came to Mr. Long. They were cast pistons. The side walls and this rib was practically one piece after the casting was made. The part e, in Figs. 3, 4 and 5, indicates the small groove that was cut around under the lower ring land to separate this side wall of the piston from the head. It went clear through the skirt, all the way around. Not opposite the wrist-pin bosses—there is a little reinforcement there to take care of that over the wrist-pin boss; otherwise, the piston will fall through—. The parts, f, in Figs. 4 and 5 was a slot extending from the lower end of the piston to this groove that was cut all the way around the piston. That went all the way through the skirt. There were six of those slots in the piston.

The parts, g, are slots that were cut between the rib that was cast on the inside of the piston, and the wrist-pin boss, and went all the way through the skirt. There were four of those slots like the g, and two like the f, making six slots. In Fig. 6, which is a cross-section showing the same general view as Fig. 3, I have a slot marked "Y"; that is in Fig. 6, but it is not in Fig. 3; that should not be in there. That was a mistake on my part.

Figs. 3, 4, 5 and 6, illustrate the piston that I saw at Mr. Long's when I came there in December, 1918. I would say that piston was being made at that time, by Mr. Long, out of aluminum alloy. They were made from sand castings. Some of the castings came from Walker M. Levett Company, New York City, when I came with

Long, in December, 1918. Others were made in St. Louis, Gilbert Foundry Company. A wooden pattern, wooden core box, was being used for making that kind of piston. The pattern itself did not differentiate from an ordinary trunk piston; the difference was all in the core box. The core box differentiated from those used in ordinary trunk pistons, just by putting in the small piece, that made this rib from the side wall of the piston to the wrist-pin boss. I could produce a core box of the kind that was being used at that time.

(Witness produces core box which is marked for identification as "Defendants' Exhibit P.")

This core box was among the patterns that Mr. Weems bought from Mr. Long. I had seen it before Mr. Weems bought it from Mr. Long. The entire core box is as it was originally—there has nothing been added. The two pieces you indicate were lost out of it, and we just made them in St. Louis yesterday, under my directions, and put them back.

Taking that core box, Exhibit P, as it stands, without those recesses on the side, which receive the lugs on the two pieces, the core box is just the same as an ordinary core box for an ordinary trunk piston.

Mr. Bruninga: I will mark the two pieces as P-1 and P-2.

(Narrative continued) P-1 and P-2 are the two ribs that extend from the side wall of the piston to the wrist-pin boss. And when in place, they make holes for the ribs.

The procedure followed by the core maker in making a core box like Exhibit P, using the two pieces in place, is as follows: The core maker prepares his sand; he removes these two ribs, P-1 and P-2, and fills this box with sand up to the position where these ribs set in. He puts these into their position, and when he is finished, fills this box with sand. Then it is swept off at the top and makes a perfect tray, in which he lays an iron plate. He turns the complete core box over with the plate, leaving the sand on the plate. Then he gently pulls this rib, P-1 and P-2, outside the box, which leaves an opening for the metal to go in where it enters the hole. Yes, after the core has been made, with the pieces, P-1 and P-2, in place, the core box is turned upside down with the metal plate, and these pieces come out of the core box with the core.

That leaves an opening in the core for the metal to run in, and become a part of the wrist-pin boss.

The core maker uses different things to make the sand stick—such as alloy, paste, molasses; a mixture. This particular core box will make only half a core, and in order to make an entire core, the core maker takes two of these halves and places them together in a perfect circle. After it is made, the core is put in an oven and baked, then the two baked parts are glued together, and that makes the complete core.

Q. 113. I understand you to say that you saw such a core box as Exhibit P, at Mr. Long's place of business when you came there?

Mr. Richey: That is objected to as leading.

A. Yes, sir.

(Narrative continued) I have had no actual experience as a molder or core maker, further than my pattern making and machinery and tool designing would go.

The thickened part in the core, between the wrist-pin boss and the top of the head, and the two thickened parts on each side of the web, are reinforcement there to strengthen that where the skirt is cut clear off from the head. The core boxes like Exhibit P, that I saw at Mr. Long's when I came there in December, 1918, had pieces very similar to P-1 and P-2. That was the first time I had seen that box. As near as I can guess, the two pieces we have here were no different from the ones in the old core box—it is just the same as this is. The groove on the side of the core box, below the part that takes these lugs of the piece P-2, is merely to hold the ribs P-1 and P-2 in position.

The reason the core box has the name "Levett Co." on it is because Mr. Levett put his name on all of the—in all of our core boxes that we shipped to them—just to identify his own castings. Walker M. Levett Company was a foundry, in New York City, and we shipped patterns to that Company. We shipped those patterns to him and he made the castings according to the patterns that we shipped him.

(Pistons Exhibits B, E, F and G are placed before the witness.)

This Exhibit B here: I recognize that as the piston used by the Franklin Company, before they used the

piston Exhibit F, which was made and patented by Mr. Long, known as Series 9.

This Exhibit E is a Series 9 Franklin piston, made from dies owned by Mr. M. K. Weems, and these castings were also made by Walker M. Levett Company.

Exhibit G is a Franklin piston, also known as the Series 10. This casting evidently came from the Franklin factory, or from Mr. Long.

Mr. Richey: The last part of the answer is objected to as argumentative and incompetent.

Mr. Bruninga:

Q. 125. Is Exhibit G a piston made by Weems? A. We make the same identical piston as this Exhibit G.

(Narrative continued) Weems makes Series 10 pistons of the same dimensions, practically the same design, only the slots opposite the wrist-pin boss run at an angle, like those in Exhibit E.

Referring to the kind of a mold that the piston Exhibit F was made in, it was made in a wood pattern and in a wood core box. The designation F.I.B., inside, was a factory mark that we put in our pistons to identify it further than the Franklin piston; to be used for factory convenience, only. It was a Series 9, Franklin piston.

Q. 131. Is that particular piston, Exhibit F, any different from the one that you saw at Mr. Long's in December, 1918?

Mr. Richey: I object to that as leading.

Mr. Bruninga: Do you want me to ask him whether it is the same?

Mr. Richey: No; you should have asked him in the beginning to compare it with the piston, but now you have led him, and of course you will get the answer that you want.

(Narrative continued) There is practically no difference between the pistons.

Q. 132. Were any pistons being made at Mr. Long's place, when you came there in December 1918, like Exhibit F?

Mr. Richey: That is objected to as leading.

(Narrative continued) Yes, sir, they were being made and put in some cars, and there was a number of them sent out for trial, to different places. I couldn't

recall just where they went to. I wouldn't say I know of any of these pistons, like Exhibit F, being made at the time that I came with Mr. Long in December, 1918. It is pretty hard to go back at that time, to be exact, to the exact design. I started working on pistons right away after I came to Mr. Long. We made an aluminum piston for Franklin cars and some for the Northway Motors. The design was practically the same as Exhibit F. Of course, they were made according to the sizes and lengths and so on, according to the factory's blue-prints.

Regarding the construction of the pistons I worked on, when I came to Mr. Long in 1918, some of them had the two ribs cast with the wrist-pin boss on one side, and not on the other side. That would allow the piston to be slotted on one side, practically the same as this one is, and no slot on the other side.

I don't know how long the wrist-pin bosses have been relieved as in Exhibit F, but it has been done ever since I knew anything about gasoline engines. That relief is put in there to keep the piston from scoring. The piston expands more than the wrist-pin does, in the line of the wrist-pin, than it does the other way. Naturally, if the pistons fit close, they are apt to score the cylinder. That was true of the ordinary trunk piston.

Mr. Richey: You mean, iron pistons?

By the Witness: Yes, sir.

(Narrative continued) That was done in trunk pistons, before I came to Long. My experience with automobiles and gasoline engines runs back to about 1909, and during that time I have worked on a good many engines and in most cases they were relieved on the side.

In Exhibit F, the groove or slot below the lowest ring land runs all the way around the piston; this was done for the convenience of machining. It was not necessary, so far as the piston structure was concerned, but it was easier to cut this groove all the way around, than it was to saw those side walls loose from the head. The purpose of the saw cut or the cut around the piston is to get the side walls loose. The practice of making that circumferential cut or slot was accomplished with a cut-off tool, in a lathe; a tool practically the same as you cut your ring groove, only a narrower tool. The reason we did not cut it part way around, just opposite these parts that the webs are connected with in Exhibit F, is that if

you cut it part way around that would answer the purpose, but it increases the cost of making the piston, by a separate operation for cross-slotting.

The change over to pistons like Exhibits E and G was made sometime in 1920, as near as I can remember. We had some metal molds made by the Walker M. Levett Company, about then. I wouldn't say positively on that date. By "we" I mean that was made by Weems; that Mr. Long was entirely out of it at that time. Mr. Long had no interest in Weems' business at all, after he sold out. As far as the making of pistons was concerned, we had to comply with his patents, as near as we could. He was paid a royalty on the tenth of every month, from the time Mr. Weems took his business, until it expired. I know that to my own knowledge. He was paid twenty cents per piston.

The reliefs in Exhibits E and G, opposite each wrist-pin boss, were cast in there. In Exhibit F they were cut at the time the piston was machined. The cut was made with a small tool, with a cam action. This tool would come down and cut a distance, and then turn it over and cut the other side. That was while I was still with Long, that we made the first cam action cut. I can notice evidence of such action on Exhibit F. It is the tool marks. By noticing this closely, you can see the feed of the return of this tool.

In Exhibit E, near the lower ring land, the skirt deflects inwardly, and has some oil holes. That inward deflection was just an offset put in there to give us a position to drill our oil holes. That was the purpose of the same deflection in Exhibit G, also.

In Exhibits E and G there are three ribs across the head, while in Exhibit F there is only one rib across the head: That was done to strengthen the piston on the inside, because we had some trouble with breakage on this Exhibit F.

I can produce a core box that was used between Exhibit F and Exhibit E. (Witness produces core box.)

Mr. Bruninga: The core box produced by the witness is marked for identification, "Defendants' Exhibit Q."

(Narrative continued) This Exhibit Q was a core box for a piston for Series 9 Franklin cars, and was started by Mr. E. C. Long. This core box was finished, after Mr. Weems bought the business this core box was finished. I

obtained it in our own shop, the shop formerly owned by Mr. Weems. It has been in the shop since about 1920; since it was returned from Walker M. Levett. This particular core box, Exhibit Q, was sent to Walker M. Levett. It forms the core for the inside of a piston, and I don't think it was ever used before it was sent to Mr. Levett.

Q. 173. Can you sketch out briefly the procedure that is followed by a core maker, in making a core with this box, Exhibit Q?

Mr. Richey: That is objected to as immaterial.

A. Yes, sir.

Mr. Bruninga:

Q. 174. Please do so; just very briefly state how a core maker would make a core with this box.

(Narrative continued) Well, with this box here, it would be all put together, because this makes a complete core. He puts this core box together and fills it with sand; separates it, and the core sets on the end. It is baked in one piece. It makes a Franklin Series 9 piston. The inside is very similar to the one in Exhibit E.

The small piston you have handed me marked on the inside "O. 1. A" is the type piston made for an Oldsmobile car or Northway Motor.

Mr. Bruninga: The piston is marked for identification as "Defendants' Exhibit B."

(Narrative continued) This is a sand cast piston. Mr. Long had one of those, or some of those castings were pistons for the Northway Motors, when I went to work for him—they were in process of machining. I wouldn't say positively whether they were completed or not, but they were in the process of machining at that time, and later there were some of them shipped to the Northway Motor Company. That was shortly after I came with Mr. Long. I don't remember just exactly, but shortly after. In the course of, I would say, two months. Those pistons that we shipped to the Northway Motors were very similar to piston, Exhibit R. Their structure, with the exception of the cross-web to hold the side walls, the same as Exhibit R. It had six vertical slots, very much like Exhibit R.

The designation O. 1. A. is just to identify this particular casting; for our own shop convenience. This particular piston bears the designation "M. K. Weems";

I couldn't tell you just exactly when that was made, but, of course, this particular piston was not made by Mr. Long. That was only a stamp that was on top of the piston to identify that it was made by Mr. M. K. Weems. That piston was used in Oldsmobile Six. It was made right around war time. I know, at the time I went to Mr. Long there was one or two of these motors at the shop at that time, having some work done on them. I won't say whether they had pistons in them or not, because that I don't know.

The designation "2.774" on top of piston, Exhibit R, signifies the size of the piston; that is the diameter in inches. The designation "5" indicates the cylinder that it fits in.

I can make drawings, and I have made drawings with Mr. Long and Weems.

Mr. Bruninga: I hand you a tracing marked "Oldsmobile Six." I will have this marked for identification as "Defendants' Exhibit S."

(Narrative continued) This is a tracing I made for an Oldsmobile Six piston, the same as in Exhibit R. There is a little difference in the piston R than the drawing S. In the top of the piston, on the inside, the drawing only shows one rib. (After examining piston.) I was under the impression that this piston had the three ribs in the top, that we later put in. When I picked it up I found there was only the one rib in this. This drawing was made for the piston as Exhibit R. After Mr. Weems took the business over some pistons like Exhibit R were made; but before Mr. Weems took it there was an Oldsmobile piston, for a Northway eight motor, which was a little different than this piston, as that bore of that cylinder is two and seven-eighths in diameter, and there was a little difference in the depression, that is, the distance between the wrist-pin boss and the top of the piston. So far as the slot and the web were concerned, the construction was just the same.

I made the drawing, Exhibit S, after Weems took the business. I couldn't say just how long after. I should judge we sold probably one hundred or one hundred and fifty of those pistons like Exhibit R, after Weems took the business. That runs from 1920 to 1930.

(Witness is handed tracing, marked for identification "Defendants' Exhibit T-1.")

This is a tracing I made for a Ford, Model T. Weems made some of those pistons, but we never made a great many, because they were too expensive to put in Ford cars. We sold some of them, back as far as 1919. That tracing was made sometime after Mr. Weems had taken the business, around—well, I'd say, in 1920, because most of these drawings were made up shortly after Mr. Weems took the business.

Those Ford pistons were made of aluminum alloy; an aluminum alloy piston was made from this drawing.

(Witness is handed a tracing marked for identification "Defendants' Exhibit T-2.")

I made this drawing near the time the Ford piston was made; in fact, we made up a number of these drawings and had patterns made for them, and made a little stock of pistons for these cars. That was the Essex, Ford. Aluminum was the metal used to make them. We sold some of these pistons in the years ranging from 1920 to 1930, probably. There was pistons in stock like that, a very short time ago. I don't recall how many Essex pistons were sold.

Regarding the other automobiles other than the Olds, Essex, Ford and Franklin, that Weems made aluminum alloy pistons for: we made up about eighty different patterns and core boxes, as far as slotted skirt pistons, same as shown in Exhibit R, in such cars as Hudson Super Six, Stutz, Marmon, McFarland—in fact, all cars that were made at that time. We did have a Chalmers Six, about 1920, and we had a Maxwell, but I don't believe that we have got a Maxwell, a drawing of the Maxwell piston, because that piston and core box was made in Mr. Long's time. Mr. Long made that box and piston himself. It was not necessary for me to make a drawing for it. I haven't a drawing of the Chalmers; there was some of those pistons that we made later, that I didn't make a drawing of.

Weems made no pistons other than the six slotted, cross-web construction; only a few cast iron pistons, for special jobs, such as tractors and stationary engines. It would be hard to say how many different kinds of pistons of the six slotted, web construction, Weems made in 1920. Some of the cars he made pistons for, in 1920, were Oldsmobile, both six and eight; Franklin cars, Series 9 and Series 8, and in 1920, we made a piston for Dusen-berg, four-cylinder racing car.

(Witness is handed drawing, marked for identification "Defendants' Exhibit T-3.")

I made this drawing in 1920. The piston for the Dusenbergs was made from this drawing. I couldn't say how many of those Long, six-slotted pistons with the cross-webs in them, Weems made during 1920. We made quite a lot of them; in fact, our shop at that time—we were very busy on making pistons.

During the first part of 1920 there was only about five men employed in the shop. Or rather, there were three men and two boys. One was an apprentice and the other was just a handy man. That was besides myself; I was still superintendent, in 1920.

Our capacity per day was very small at that time, because we was not hardly fixed to make pistons. But we did manage to turn out quite a—tool up a few with our common engine lathes. Most of the pistons that we sold we sold to Franklin dealers throughout the country. The dealers I remember was the Franklin Motor Company in Chicago; and there was a number of pistons—quite a lot of them—sold to the Franklin dealer in St. Louis; in fact, there was a number of Franklin dealers all over the United States who bought pistons from us at that time. We also had a customer in Wichita Falls, Texas, that bought lots of pistons from us. Their business started early in 1920, and continued along for a number of years.

Q. 244. And those were all of the six-slotted, cross-web type like these exhibits that are before you on the table, Exhibits E, F and G?

Mr. Richey: That is objected to as leading.

A. Yes, sir; they were all made of that type, because that was the only pistons we made, was the pistons with the six slots.

(Narrative continued) Mr. Long was being paid a royalty on every one at that time. We have been making Long pistons up to, I will say, the first of the year. Since then our shop has been shut down.

Yes, there were some of those six-slotted, cross-web type pistons, shipped to the Maxwell Company. I can't recall the dates, now, I don't remember whether we shipped any to the Chalmers Company.

I should say Weems made several thousands of those Long pistons in that period before he died. According to the old books, from about January, 1919, to July—I

forget just what year—1924, we made about fifty thousand dollars worth of pistons.

Mr. Richey: I object to the answer as testifying to the contents of records.

(Narrative continued) I made a check-up of the Weems business before I bought it; I knew pretty well what the business was, being with it from its infancy. Weems did some advertising. He advertised in Motor Age, and a few other trade papers; I don't recall just what they were, now.

(Witness' attention is called to the July 7th, 1921, number of Motor Age, page 124, containing an advertisement entitled "The 'Long' Type Non-Expanding Aluminum Alloy Piston. M. K. Weems, Licensed Manufacturer.")

This is an advertisement by the Mr. Weems whom we have been talking about, and I recognize it.

Q. 255. Of what kind of a piston is the advertisement?

Mr. Richey: That is objected to, as the advertisement is the best evidence.

(Narrative continued) Well, that has the appearance of a Franklin piston. That cut was not used in Mr. Weems' other advertisements. As I remember, this cut here was made by the Motor Age, themselves.

Mr. Bruninga: Page 124 of Motor Age, is marked for identification as "Defendants' Exhibit U."

(Narrative continued) I have some books of the Weems Company, which I brought with me. I came in possession of those books, (which are marked for identification as "Defendants' Exhibits V, V-1, V-2, V-3, V-4, V-5, V-6, V-7") when I bought the business from the Weems estate.

Exhibit V is the book of inventory, stock of machinery and parts and materials, pistons, finished and unfinished, that were in the shop when Mr. Weems took possession. A man by the name of Royalty, made out the inventory. I don't remember his first name. Yes, it was Sidney. He is now located at Jacksonville, Illinois. He was with Weems when Weems took over the business; before that he worked for Mr. Long. I don't know just how long. He was with Mr. Long at the time I was with him.

I can identify Exhibit V, that particular book. I had nothing to do with the taking of the inventory, however. I recognize Mr. Royalty's handwriting, and to my knowledge, it is Mr. Royalty's handwriting in that book.

Q. 273. Page 28 of that book bears the following notations:

"4 Hup pistons nearly finished.
8 Maxwell pistons 14½ lbs. aluminum.
11 Holmes pistons 19¾ lbs. aluminum.
5 Hup pistons ¾ finished.
4 Overland 13 cast's 5¾ lbs. aluminum.
4 Hup pistons 5 lbs. aluminum.
16 Northway pistons almost finished.
24 Aluminum pistons Packard twin six 38 lbs.
6 Franklin Series 8 pistons 12½ pounds.
1 Ford aluminum 2."

Page 29 bears the following designations:

"4 Overland finished aluminum complete pistons Fin. goods 20.00.
10½ lbs. finished Franklin pistons .21 Fin. goods.
65 patterns & core box for pistons, etc. 3.00 patterns 195.00."

Have you any recollection, yourself, about those items, as to whether or not they were in the shop at that time?

Mr. Richey: I object to the question as leading.

A. Well, they were in the shop at the time the inventory was taken, and there is some of those patterns there yet.

(Narrative continued) The statement "65 patterns and core boxes for Pistons" refers to such as the Franklin and Maxwell and Oldsmobile, and these various types of pistons such as Exhibits E and R. There were a few other type pistons, a few patterns there for iron pistons used in stationary engines and tractors. The "4 Overland finished aluminum complete pistons" has reference, I think, to an Overland. That was a piston with the six slots. The "10½ lbs. finished Franklin pistons" refers to the six slot pistons. The "16 Northway piston almost finished" refers to six slot pistons of the same type as Exhibit R.

The "Aluminum pistons Packard twin six," item 47.50 were pistons made for the six slot type, for test purposes, for the Packard Company. They were shipped out to the Packard Company—if I remember right, I think we just turned those pistons back to Mr. Long and he took care of that shipment himself. Judging from the price, \$47.50, I imagine they were partly finished.

The eight Maxwell pistons, shown on page 28, were of the six slot type, too. The Hup piston—I think that was an iron piston that was there. I think all three items referring to Hup pistons were all iron pistons. The one Ford aluminum piston was of the six slot type, the same as Exhibit B.

Defendants' Exhibit V-1 is a cash book; in other words, it is a book that shows what we bought in the way of castings; also what we sold in the way of castings. The book was kept by a Miss Landon. Her first name was Anna. I don't know exactly where she is, but I think she is in Davenport, now. She is married, and I do not know her married name; I have not seen her for at least four or five years. She kept the books from the first of November, 1919, until about 1921—I don't know the exact date that we made the change, but she was with us probably about two years. I am familiar with her handwriting and would say that most of this book is in her handwriting. I think there are some items in the back of the book that was written by one of the other girls that came later—a Miss Erke. I cannot think of her first name, but she is in Denver. I do not know her address. I wouldn't swear to her handwriting, because there was two or three other girls that followed her and I couldn't tell just when she did make entries in the book.

I am familiar with this book, Exhibit V-1; I saw Miss Landon keep the book, and make the entries. The item, on page 3, "Walker M. Levett Co. 164.03" refers to some castings of the Long type piston, because that is all we had made—castings we had made by Levett. Another item on page 3, on November 28, 1919, "Walker M. Levett Co. 316.33"; that was for aluminum alloy pistons. We did no other business with Walker M. Levett Company, except for aluminum alloy pistons. The handwriting on those two items noted, under November 10 and November 28, 1919, is Miss Landon's.

Another item for December 6th, 1919, on page 7 of Exhibit V-1, "Walker M. Levett Co. 243.13," is for cast-

ings. Those other items on page 6, under dates of December 8, December 12,—those are all for aluminum piston castings.

I can remember that those castings were coming through at that time from Walker M. Levett Company and being sold, and shipped out to these different dealers. Those castings were machined in the shop, and the pistons were of the six-slotted type. Walker M. Levett Company made no other castings for us, except for the six-slotted type, until later years; not up until 1925. We got some plain aluminum pistons, such as used in the Reo cars, of the solid type.

On page 7 of Exhibit V-1, under December 6, 1919, is the following entry: "E. C. Long Royalties for sales pistons 27.40"; that item was the royalty that we paid Mr. Long. We paid him that royalty each month; between the first and tenth of every month.

The items on the following pages:

"Page 11, January 6, 1920, E. C. Long, Royalties 24.00;

Page 15, under date of February 7, E. C. Long, Royalty 80.60;

Page 19, March 3, E. C. Long, Royalty 127.80;

Page 25, April 9, E. C. Long, 157.60;

Page 31, May 10, E. C. Long, Royalties 106.40;

Page 37, June 8, 1920, E. C. Long, royalties 138.40;

Page 41, July 8, E. C. Long 117.80;

Page 47, August 7, E. C. Long 96.40;

Page 53, September 10, E. C. Long 151.60;

Page 57, October 9, 1920, E. C. Long 87.20;

Page 63, November 10, 1920, E. C. Long 103.40;

Page 69, December 10, 1920, E. C. Long 69.20;

Page 73, January 10, 1921, E. C. Long 71.80."

These were all royalties that were paid Mr. Long at the rate of twenty cents apiece for each piston. The items are in Miss Landon's handwriting. Mr. Long was paid twenty cents a piston royalty between the first and tenth of each month, on the pistons manufactured. The way we did that, you know, at the last operation that the piston went through, we had that boy keep a record of every piston. That was turned in to the office and that was what Mr. Long collected his royalty on.

On page 18 of "Defendants' Exhibit V-1," an item under March 12, 1920, reads, "Franklin Motor Car Co.

So. Bend, Ind. 327.62"; that represents pistons that were shipped to the Franklin Motor Car Company at South Bend. I have no recollection, other than the records on the book, of that shipment; that is all.

Mr. Richey: I object to the testimony as incompetent.

(Narrative continued) On page 24 of "Defendants' Exhibit V-1," under date of April 9, 1920, is the item, "Northway Motor & Mfg. Co., Detroit 35.70": that represents the pistons Mr. Long started there in the shop and we finished them up and shipped them to the Northway Motor Company. I do not know anything about the notation above the 35.70 that looks like L 8. I have a recollection of that transaction, independently of that record, however. I remember of making up those pistons and that we had some trouble in getting wrist-pins for them, and we had the Northway Motor Company send us wrist-pins for them. That is one thing that makes me remember this particular shipment. They were the pistons with the six slots, similar to this Exhibit B.

On the same page, 24, there are two items under date of April 19, 1924, "Franklin Ross Motor St. Louis": I can remember that transaction. We shipped those—we shipped quite a lot of pistons to Franklin Ross at St. Louis. They were Franklin Dealers at that time. They sold the Franklin car, here in St. Louis.

On page 14 of "Defendants' Exhibit V-1," under date of February 5, 1920, is an item "Chas. L. Bartlett Jan. Acct. 141.03": according to my recollection of that transaction, we reground the pistons in that car and fit them with a set of these six slot pistons—we reground the cylinders; fitted the cylinders with six slot pistons. The Long six slot pistons. I recall that transaction independently of this record, because I bought the car afterwards. I bought the car in about 1920—I think it was about in October, if I remember right.

On page 58 of "Defendants' Exhibit V-1," under date of October 21, 1920, there is the entry, "Chas. Bartlett, Local 1420.00": That transaction was the sale of a new car. I remember that transaction myself, independent of this record. The entry on October 22, 1920, of "Chas. Chadwick 750.00" was the cash payment on that Bartlett car, by myself. The pistons in that car were the six slot Long type piston.

"Defendants' Exhibit V-2" is kind of a ledger, is what you would call it, of the M. K. Weems Company. It was kept by Miss Landon.

Under Account No. 31, consisting of five pages, there are entries under the heading "Sales Pistons": Those represent the sales of the pistons, that is, the sales were lumped altogether. It just shows the amount of pistons that were sold each month, and for a period of months. That is Miss Landon's handwriting there, and that is not (indicating on book). This is her handwriting (indicating on exhibit book); but this item does not apply to piston sales, this particular part right here (indicating on exhibit book). The dates are June 30 and July 31, 1921.

The section entitled "31 A," one sheet, entitled "Sales Iron Pistons" relates to iron pistons; some of those are re-sale pistons, pistons that we bought in a semi-finished state. Account No. 31 all relates to aluminum pistons, of the six slot pistons, Long type. I think that these items were taken from another book, and this J, I imagine, means the journal. I do not have that Journal—that book has been destroyed. We had that book until probably six months ago, and we wanted to use the ledger itself, and we just opened it up and shook all the leaves out in the paper basket, and they were buried. I have investigated and found that is what became of the book.

Under Account 44, in "Defendants' Exhibit V-2," is a series of entries, beginning with November, 1919, to July 31, 1921, entitled "Cost of Pistons Sold". That relates to the Long type pistons entirely, and is in Miss Landon's handwriting.

Exhibit V-3 is a book of purchases, book of entry of purchases, of different things, such as castings and repair parts, and things of that kind. There are a number of entries in this book, "Walker Levett and Co.": Those were all for piston castings. Those were the only transactions we had with Walker Levett Company, for castings and for molds for piston castings.

"Defendants' Exhibit V-4" is an entry book consisting of sales, costs, factory expense, and such items. The item on page 6 of this book, under date of December 31, 1919, reading, "E. C. Long Chas. Bartlett for 6 pistons @ .90; 6 wrist pins @ .80 and 18 rings @ .80" was for pistons we put in that Franklin car that I purchased from Mr. Weems, that he took in trade with Mr. Bartlett, about which I previously testified.

On page 10, under date of January 23, 1920, is an item under "Advertising E. C. Long, Giving Mr. Long Cost price on pistons etc. used in Mr. Chas. Bartlett's car"; this car was tore down at the time Mr. Weems bought the business, and Mr. Weems made those pistons for Mr. Long at practically cost price.

On the page opposite page 1, of "Defendants' Exhibit V-4," the statement reading, "Started new system piston manufacture Aug. 17, 1920. Had men come to office for a short meeting so as to give them better understanding of our methods," is in Miss Landon's handwriting. She referred to the time when we started on our new tooling process making pistons at that time. We got our automatic tooler up and a new way of boring wrist-pin holes. We felt we were really in production at that time. That was for principally Franklin pistons of the Long type. We made some other—no other type, with the exception of for the various cars; all of the same type pistons, only being made for different cars, under different specifications.

I don't know who put "Did not keep this Up," there. It is not the same handwriting as the other.

I think we had about ten men employed in the shop at that time, working on pistons and other work, too. We had four men working on pistons practically all the time. I don't remember our daily output about that time, August 17, 1920.

The book handed me, marked for identification "Defendants' Exhibit V-5," is a daily time book. It starts out in Miss Landon's handwriting, on page 1. The entry of Charles Chadwick refers to myself. S. D. Royalty is the entry of the man I previously referred to, and "Anna M. Landon" was the one that kept the books. Louisa Rogers was a stenographer at that time.

The book handed me, marked for identification, "Defendants' Exhibit V-6" is a daily time book, from March, 1921, to August 5, 1922; it is a continuation of "Defendants' Exhibit V-5."

"Defendants' Exhibit V-7, dating from August 5, 1922, to December 22, 1923" is the time book from August 5, 1922 to December 22, 1923. It is a continuation of "Defendants' Exhibit V-6."

My only knowledge of Edward J. Gulick, who at one time resided in Elkhart, Indiana, is only just through the patents of his pistons; that is all. That is the only thing I know about him.

As far as I know, Edward J. Gulick or the Aluminum Company of America never offered me, or Long or Weems, any piston which would function in automobile engines, nor did the Cleveland Trust Company ever do that, as far as I know. All I know is that Gulick got a patent; that is all. I seen it in the patent records; that is all. I believe I have met the Mr. McCoy who is in the room here, before. I think he came to Quincy one time, and he looked over the piston shop. I don't believe he told me who he was representing. I didn't know then that he was representing the Cleveland Trust Company at that time. I don't recall the name of the man with him. I could describe him; he was tall and slender, and he had dark hair. He was the man who cross-examined me in Detroit, at the time of taking testimony there, in one of Mr. Long's interferences. Mr. Watts; I believe that is the man.

They talked of the construction of the piston, and I believe they brought up the Oldsmobile Eight piston. That is the one we talked of mostly at that time. They did not tell me that they were collecting evidence to be used against Mr. Long; not when they were in Quincy. They did not tell me that they were collecting evidence against me or Mr. Weems, for a possible suit. I showed them around the shop—I don't think there was anything they missed. I think I showed them about everything there was. But neither of them told me that they were attorneys representing somebody else. I just thought maybe they were interested parties, interested in our system of manufacturing pistons. Yes, I had shown a number of other people through the shop; showed them our equipment for turning out pistons, which we were very proud of at that time, and, naturally, we wanted to show it to every one. Some of them came in to be curious and some would be salesmen from outside.

And thereupon, the further taking of the deposition was adjourned until April 29, 1932, at 9:30 o'clock, A.M.

Met pursuant to adjournment as above, on April 29, 1932, at 9:30 o'clock A.M.

The following proceedings were had:

Mr. Bruninga: I offer in evidence "Defendants' Exhibits O, P, Q, R, S, T-1, T-2, T-3 and U."

(Narrative continued) The books I have produced here, "Defendants' Exhibits V, V-1, V-2, V-3, V-4, V-5, V-6 and V-7," are all the books that I have been able to find, of the Weems business, so far. I have looked for other books, but they have been destroyed. I uncovered them, or found them, just within the last week. I don't know just really what was lost; they were just put in different places where they would be out of the way, and there was no occasion to move them. They were practically lost for a while, because they were covered up with other—. I have no bills, or checks, or other data, relating to the matters given in these books. As to the procedure, in keeping these books, practically all the entries in those books is as to shipments made, or charges growing out of that, that was given in by myself and Mr. Royalty, at that time. Mr. Royalty had charge of the Service Department, and I had charge of the machine shop.

About the matter relating to these Long shipments, when we shipped out Long pistons; we had what we call a requisition, and we would make out the requisition and turn it in to the office, for pistons and other materials. Of course, those requisitions were destroyed after Miss Landon made the entries in her books. I made out the requisitions, as far as the Long six slot pistons were concerned, and I gave them to Miss Landon. During the latter part of 1919, beginning with the time that Weems took over, to and including the year 1920, and the part of 1921, up to the time that Miss Landon left, I was in close contact with the situation, particularly with reference to Long six slot pistons. Occasionally I referred to the books, myself. I never had occasion to check them, to see whether the entries were properly made. Of course, at times they would ask me about certain parts, charges, that I had to rearrange my requisition; but I was in close contact with all the office work.

Referring to the transaction about the Bartlett automobile, which I purchased later on, the core box used in making the cores for those pistons, was an old wooden core box. There is no core box before me, that those pistons or cores were made from.

I remember Mr. Long going to Syracuse during the time I was with him, and prior to the time that Weems took over the business. That occasion was in March, 1919, or the early part of 1919. I remembered about it because one thing that impressed me more than anything

else was that Mr. Long was at Syracuse, and he telephoned me to make him up some more pistons and send them for trial. They were the six slot kind of pistons (indicating exhibit) like that Exhibit F.

Yes, I have heard of Mr. Gunn, of the Packard Company—or, I couldn't say whether his name was Mr. Gunn or not, but I remember one of the Packard men being in the shop there, that was around with us for some little time. I remember there was pistons shipped to the Packard Company, but I couldn't relate any dates on that. They were the six slot pistons. That was the R pistons (indicating Exhibit R). I don't remember whether that was before or after Mr. Weems took over the business.

These pistons, Exhibits E, F, G and R, have a relief space in the region of the wrist pin bosses: Those relief spaces were always put on there, on the six slot cross-web Long pistons, while I was with Weems. There is no time that we ever made any pistons that that relief was not put on, either cast in the molds or cut after the pistons were turned.

I remember, very definitely, a Mohrenstecher car; it was a Franklin, Series 9; one of the first Series 9 models. I think it was made in 1916.

Mr. Richey: I object to that part of the answer that says it was made in 1916, as being hearsay.

(Narrative continued) I have been familiar with Franklin automobiles since 1918, in December, was my first experience with any Franklin Service. I had seen Franklin automobiles and driven them before that. I had seen a 1916 Franklin automobile before that time, yes, sir. I saw a 1916 Franklin shortly after it was put on the market.

The Mohrenstecher car was a car that had given a good deal of trouble. I worked for Mr. Mohrenstecher after Mr. Weems had bought Mr. Long's business, and made an agreement with him to take that car out to our place and recondition the cylinders and put in a new set of pistons, for just actual cost, because Mr. Mohrenstecher had so much trouble with his car that we felt like we were doing him a favor by making this free service.

Q. 461. What did you do?

Mr. Richey: I still object to the testimony regarding the trouble with this car as hearsay.

A. We ground the cylinders, and we fitted it up with pistons, the same as Exhibit F.

(Narrative continued) That was done some time in 1920. We took some pistons out of the car—not exactly like this; they had a U-slot on one side and a T-slot on the other side. I imagine it was a trunk piston. There was not much difference between that and the present piston, that is, on the inside. The horizontal part of the T was right up under the—just below the first ring land. The vertical part of the T was in the center of the skirt, that is, opposite the wrist-pin boss. I mean between the wrist-pin bosses, opposite, not along the line of the wrist-pin boss. And on the other side was a U-slot. There was two slots up the side and then across, but the slots didn't go the full length of the skirt of the piston.

(Witness is handed photostat marked for identification, "Defendants' Exhibit W.")

Those six figures represent just a common trunk piston. The piston that I took out of the Mohrenstecher car was very much the same as the piston shown by Exhibit W, with the exception it had a rib extending from the side wall of the piston to the wrist-pin boss, on one side, and nothing on the other side. That was the piston I took out. I could make a sketch, on Exhibit W, showing any differences, or any additions, on the piston taken out of that Mohrenstecher car.

(Witness makes sketch on Exhibit W, as requested.)

I have indicated only the changes, on Figs. 1 and 4. Those slots extended all the way through the piston wall. I testified that that piston had a web on the inside, but I didn't show that. I will show that on Fig. 6 (sketching on exhibit). I have sketched a web on Fig. 6 and also a web on Fig. 5; there was just a single web in that piston. That web connected on the side that showed the T-slot. I can sketch it, also, on Fig. 4, where that web was. (Sketches on Exhibit.) I have shown two webs extending from one side of the piston, in Fig. 4, and only one web, in Fig. 5; it is only on one side of the piston, but there were two webs. I mean, it was only one side of the piston, from the wrist-pin bosses to the piston wall. That was the construction of the piston that I took out of the Mohrenstecher car. The condition of the pistons was not so bad, but the condition of the

cylinders was terrible. It was such a poor job boring the cylinders, that it was impossible for the piston to function properly with the cylinder in that condition. The cylinder was bored tapered. As for the pistons, I believe there was two or three of them that was scored, but at the very top of the piston, back in the ring lands; the rings was stuck tight in the piston, and one or two of those cylinders—I don't remember whether it was one or two, but I am positive there was one of them. The pistons were junked; they were thrown out in the junk pile. I don't know where they are now. I have looked around and tried to find something—some of those pistons, but, of course, that has been a long time ago, and all that stuff was evidently taken out. Those were the only T-slot pistons that I remember and could identify. That was in the year 1920, that I took those pistons out of the Mohrenstecher car, and I put in pistons like Exhibit F, yes. The pistons that I put back in, worked fine. I kept track of the car for quite a while. We kept a check on the car for some time after. I don't know who put those T-slot pistons in Mr. Mohrenstecher's car. I didn't put them in, and they were not put in while I was with Long. I know, because if there had been I would probably have made up the pistons, or they would have been made under my direction, because everything that was made in the shop went through my hands.

Mr. Bruninga: I offer in evidence, "Defendants' Exhibit W."

Mr. Bruninga: That is all.

Cross Examination by Mr. Richey.

I couldn't tell you the exact date of this telephone conversation with Mr. Long, from Syracuse, in March, 1919. I wouldn't swear to the part of the conversation about Mr. Long saying he wanted to show those pistons to Mr. Stellman. I don't remember whether he said he wanted to show them to Mr. Stellman. He said he wanted them for test purposes at the Franklin plant. I sent two sets, twelve, as near as I can remember, and they were like Exhibit F, here.

Mr. Long took some of the pistons with him when he went to Syracuse, like Exhibit F. I would not say positively how many he took, but I know he took a set, enough to equip a motor with—that is six. I don't remember the exact conversations we had when he came back from

Syracuse, any further than that the test was very satisfactory at the factory. I don't think he said that he had shown Mr. Stellman any of the pistons he took with him, but I don't remember. When he talked to me over the telephone he did not mention any particular parties he had shown the pistons to, further than the engineers of the Franklin Company. When he came back he confirmed that, but did not mention the names of the engineers—he might have, but I would not say positively the names of the engineers, at all. I don't remember whether he said he had shown them to anybody except the engineers of the Franklin Company, either over the telephone, or when he returned. I don't remember that part of it.

I shipped these Exhibit R pistons to the Packard Company for the purpose of having them test them out. To my knowledge they never adopted this piston, and we never sold any of them to the Packard Company. I don't remember whether those pistons were shipped to the Packard Company before or after Mr. Weems took the business.

We also shipped some of these six-slot pistons to the Northway Motor Company and to Maxwell, I think at that time, the Chalmers Company. I can't recall any others now. The Maxwell Company did not adopt this piston as standard equipment, and neither did the Northway.

The pistons used in the Mohrenstecher car were aluminum pistons. That was one of Mr. Long's designs, made prior to this six-slot piston. I saw other designs of pistons made by Mr. Long. There was a number of pistons around there that Mr. Long made for customers. Some were slotted one way and some another, and hard to be described, the different ways the pistons were slotted. I saw a number of different designs of pistons that Mr. Long had made—they were around the place there, when I went there.

Part of the trouble with the pistons in the Mohrenstecher car was, of course, piston slap, because the cylinders was so large at the bottom that the piston naturally would be loose at the downward stroke of the shaft. You bring the piston down where it couldn't help but rattle. There was piston slap and piston sticking at the same time. Kind of a double evil affair, yes, sir.

The pistons didn't seem to be collapsed—the piston seemed to be in perfect condition, with the exception of

one in particular. The cylinder was so much smaller at the top that when the piston would go at the top it would stick in the top of the cylinder and naturally it scored the piston at the ring land. In that way it tightened the rings in the piston, and the rings couldn't expand out along the cylinder wall.

Some of the other designs of pistons I saw around there at Mr. Long's, except the six slot piston, had evidences of scoring. I seen some of them that we put in and made trials with and taken out, and they would be scored on the side, and some would even be practically melted, in places. Mr. Long made many efforts to get a satisfactory aluminum piston before he got to this six-slotted piston. In his experiments he made a number of different kinds, of different shapes, and a number of them I saw around there.

I would not say they all showed evidences of failure until this six-slotted one, because he had some there that he made tests with, that didn't show any particular score or damage to the piston after it made the run. But a good many of them did.

I saw them put in just one piston. They removed one cylinder and installed the piston in there to make a test, and then took it out to see the results. This was not a block test. In the Franklin motor you can remove one cylinder and not interfere with the rest, and in that way they could install the piston and go out and make the test run with it and come back. We finally settled on this six slot piston and the only car manufacturer that adopted that was the Franklin—and the Holmes adopted the same piston. I don't know just how long Holmes used it. They failed a good many years ago, and I know they used it up to the time they failed.

I spoke of seeing iron pistons that had a relief around the bosses; that was to keep the piston from scoring the cylinder due to pin expansion. It would expand the piston more if they ran with the wrist pin, than it would the other way. The piston was originally fit with a clearance, but you have to allow more clearance on the side than you do the other way. You have to do that because if the pin fit tight into a piston—of course, take a piston with an oscillating pin, that doesn't make so much difference, but a pin that is fit absolutely tight in a piston, and loose on the connecting line, there is no way for that to slide on the wrist pin, due to the expansion, and the result of it is that it forces that wall out. The

cylinder wall is expanded, too, but doesn't get the extreme heat that your piston gets. So, even when there is an iron piston and an iron cylinder, there is danger of the iron piston expanding out and scoring the cylinder, and for that reason this relief was put in.

I couldn't say the exact number of aluminum pistons with slotted skirts the Weems Company made and sold in the year 1919, or anywhere near it. In the year '19, we took that business at such a late time that there probably was not more than maybe one hundred pistons made in the year 1919. That is just what Mr. Weems did; I don't know how many Mr. Long made and sold. In the year 1920 the Weems Company sold in the neighborhood of a thousand pistons. There were several years there that we ran along pretty near the same. In 1921 we probably made a little more than that; we probably ran—that would run three or four thousand, I guess, in the second year. Let me see: 1921 and 1922—that was when we had the biggest run on those. We had about the same run in 1921 as in 1922. In 1923 that began to slow down a little bit at that time. I couldn't tell you just how many pistons we made that year. That is hard to remember. It naturally began to go down a little, because we were not getting as much of the cylinder grinding shipped to us from all over the country, that we had in the early part. 1921 and 1922 were our biggest years.

Yes, during those years there were millions of pistons being put in motors, both in original installations and replacements, so that what we sold was a mere drop in the bucket. I should judge that a great number of those millions of pistons sold from 1920 on, were aluminum pistons sold by others. A great many of them were sold to the car manufacturers from 1920 on, in original installations.

I don't know who sold these aluminum pistons. There is a number of different kinds of pistons that was in the automobiles that I couldn't tell you anything about who made the pistons, unless I took one of them out of the car, but I remember seeing the Lynite pistons, and that was about the—I know they were Lynite, because I know they had a terrible black eye. The Lynite was a trunk type piston, and they never were successful until they put a slot up the side; but after they were slotted they were successful.

The trouble with these trunk type aluminum pistons that were such a failure, was that they had such an un-

usual clearance that when the motor was cold they would slap and make a terrible noise, and then when the motor would warm up they would expand more than the cylinder wall, so much more that they would stick in the cylinders.

I did the red ink work on the drawing, Exhibit O, yesterday morning, in Mr. Bruninga's office. It was made for the purpose of my examination. Mr. Bruninga asked me to sketch this drawing to show that the ribs could be added to a trunk type of piston, and also add these slots to it—that was the purpose in my making the drawing.

Referring to those particular pistons on counsel table (Exhibits E, F, G and R), I seen E and R and the F pistons before, because they were made by myself.

XQ. 81. Well, when you say that you just say that you made all these pistons, and therefore you made these, but I am asking when do you have any distinct recollection of having seen them, independent of any argument that you must have made them?

(Narrative continued) The first time I seen them was right here in the office—that was when I came in Tuesday. I saw Exhibit R about two weeks ago, when Mr. Wilkinson, or his man, brought that from Hannibal up there and showed it to me. I saw both Mr. Bruninga and Mr. Wilkinson, his assistant, at Quincy about two weeks ago. That was the first time I saw this Exhibit R; they brought it up there and showed it to me.

Neither Mr. Bruninga or Mr. Wilkinson told me that if I saw you or Mr. McCoy, or anybody representing the plaintiffs in this case, that I was to refuse to answer any questions that I was asked. Nor did they tell me that I was to reply to anything that you asked me, by telling you that I would answer that question on the witness stand.

I have been stopping at the Mayfair, here in St. Louis. Mr. Stellman is not, to my knowledge, stopping there.

Referring to this core box, Exhibit P: Mr. Long had that box made up. It is one that he left there at the place. Evidently that box had been shipped to Levett, and Levett always put his name in his castings. I don't know when it was shipped to or back from Levett. It has been at Quincy ever since Mr. Weems took the business over, in December, 1919. That was among the patterns that came to us, and it has not been shipped down to

Mr. Levett since then. I don't know how long it has been since this core box was used—it has not been used since Mr. Weems took the business.

"These holes that run through the box, from the bottom of the slots, is just a convenience for the core maker to make the—to get the core out of the box.

The Levett Company was in the business of making aluminum pistons during the time the Weems Company was making and selling pistons—we got pistons from the Levett Company as long as they were in business. Levett and Company also sold aluminum pistons to the trade in general.

In connection with Exhibit T-1, I said that this six slot piston, shown in Exhibits E, F, G and B, was too expensive for the Ford. It cost us too much money to make it. We had no dies for making the piston, and we had to pay a dollar a pound for the metal, and the piston casting itself cost about two and a half dollars. By the time we machined them, it made the job too expensive for the average Ford owner.

Referring to this slot—horizontal slot—under the bottom land, Mr. Long and I worked that out together. That is, cutting the slot all the way around was worked out by he and I before I went there with him. I had not done any work with him on it before I went there. The design of these six slot pistons, as we have here—Exhibits E, F, G and B, was not entirely completed until after I went to Mr. Long's place. They had the ribs in them as they have them now, but we made some little changes in cutting the groove around, to make our machining a little easier. We also made a metal core box, after I went to work on it with him, that showed three ribs in the inside, at the top of the piston, instead of one like is in Exhibit F. I have named practically all the changes that I made in pistons like these exhibits after I went to work for Mr. Long. There were no other changes made further then when they had the dies made, of course, naturally, we cast the relief, so we would not have to cut that relief after the piston was machined. That is all the changes I remember at present, but I would not say that was all of them.

We began to make the pistons with the three ribs and the head, like shown in Exhibit E, let me see: If you take core box, Q, we started before Mr. Long left, that is, before he sold the business to Mr. Weems, and we finished it up after Mr. Weems took the business. Just

how much Mr. Long had done on it, I couldn't say now. But we didn't make them with the three ribs and head until after Mr. Weems took over the business.

I can't remember the exact time Mr. McCoy and Mr. Watts came to see me in Quincy, because I have nothing that makes me remember that date.

Yes, I said I was very open with them, and showed them everything regarding these Long pistons. I was very proud of our process of machining and was glad to show it to anyone who came along. I did not show them these books, Exhibits V to V-7, or either of the core boxes, Exhibits P or Q. They did not tell me that they represented any interest that was hostile to us. I don't think anybody has said anything to me about your representing hostile interests to this time. I knew, when I was on the stand in Detroit, that Mr. McCoy was for the Aluminum Company of America, but I never knew it until I met him in Detroit—I mean Mr. Watts. Since then I have produced these books and these core boxes. They have been in the building and have been in my possession all the time.

XQ. 130. Mr. McCoy and Mr. Watts talked to you and Mr. Weems both, didn't they?

Mr. Bruninga: That is objected to, because Mr. Weems is dead.

Mr. Richey:

XQ. 131. Mr. Weems was present at the conversation, or some of it, was he not?

Mr. Bruninga: Same objection.

(Narrative continued) Not to my knowledge. They talked to me out in the shop, and I wouldn't say positively whether they went to the office or not. That I couldn't positively say, because I didn't go to the office with them. Everything I told them then was true, as near as I—I had no occasion to tell them anything but the truth.

I know an attorney in Quincy, named Lancaster. I don't think I went to Mr. Lancaster's office with Mr. Watts, Mr. McCoy and Mr. Weems. I don't think I did; I don't remember that I did. I don't know whether they went to Mr. Lancaster's office, either.

Mr. Bruninga: Has counsel another affidavit that he is going to flash?

Mr. Richey: Have we flashed an affidavit in this case, yet? You said "another."

Mr. Bruninga: I am talking about affidavits in other proceedings, that have been flashed by witnesses.

Mr. Richey: What other proceedings?

Mr. Bruninga: Interferences involving the Long and Gulick application; flashed by Mr. Gilbert, and carefully worded so as only to include his own company and not his predecessor.

Mr. Richey: Do you want that in the record?

Mr. Bruninga: I do want that in the record.

Mr. Richey: We object to counsel testifying; he is not under oath, and is manifestly testifying to something that is hearsay with him, and we also deny the statement that he makes.

The record in the interference proceedings will show that Mr. Gilbert was called and testified.

Mr. Bruninga, you have reference to interference numbers 49,569, 49,570 and 49,571?

Mr. Bruninga: I do not know what interference it was. At the proper time it will be introduced.

Mr. Richey: You have made charges here and it is up to you to make them definite.

Mr. Bruninga: At the proper time they will be made definite.

Mr. Richey: I produce the interference records in which Mr. Gilbert testified on behalf of the party, Gulick; these are the records that were used in the United States Court of Customs and Patent Appeals, and ask that they be marked for identification, as "Plaintiffs' Exhibits 1 and 2."

(The record in Case No. 2608 was thereupon marked "Plaintiffs' Exhibit No. 1" and the record in Case No. 2609 was marked "Plaintiffs' Exhibit No. 2.")

Mr. Richey: I will state that these are the only two that I have any recollection of ever having examined Mr. Gilbert in, and unless counsel for the other side is pettifogging, I invite him to point out where we at any time flashed this so-called affidavit of Mr. Gilbert, in his examination.

Mr. Bruninga: Counsel admits he made a mistake. What I had in mind was the affidavit signed by Albert R. Bush, as to a transaction of the Bush

Foundry & Metal Wheel Company of Quincy, Illinois, as distinguished from the predecessor of the Bush Foundry & Metal Wheel Company, in Interference 49,571, Long's record, pages 198 and 199; Long's record in that interference, pages 193 and 201.

If we both have it out of our systems, I will wipe it out, or let it stand.

Mr. Richey: We will let it stand.

Mr. Bruninga: Are you willing to stipulate the pages of that testimony that I just referred to?

Mr. Richey: No, not alone; not without the entire record. I will put in the whole record, in the other cases.

Mr. Bruninga: No.

Mr. Richey: Mr. Gehr was the cross-examiner there, and I do not see anything at all reprehensible, or to be criticized, about his confronting the witness with an affidavit on cross-examination. As I understand that, it is perfectly proper procedure.

Mr. Bruninga: Counsel may think it is proper procedure, but I do not.

Mr. Richey: I am not willing that part of the record should go in; I think the whole record should go in. If counsel intends to make any charges, I think, in fairness to Mr. Gehr, the whole record should go in, and that charges should not be made on one or two pages of the record.

(To Mr. Bruninga): Is that all?

Mr. Bruninga: That is all.

(Witness is shown drawing patent to Long, No. 1,489,499, dated April 8, 1924.)

(Narrative continued) I saw some pistons like that at Mr. Long's place of business, when I went to work there. I don't remember whether or not I made any pistons like that after I went to work with Mr. Long. I would not say how many of them I saw when I went to work for Mr. Long. A number of them were laying around there. I could not even express the number. There was not a hundred; I would say there was four or a dozen, but I saw several pistons around there that were slotted in that way, and some were slotted different. There were some of these pistons, like shown in the drawing of this patent, there when Mr. Weems took the business over. I don't think they were included in

the inventory, only just as scrap. The pistons very similar to that, is what we took out of the Mohrenstecher car. The slots I don't think were just exactly the same as they are there.

I never made any entries myself in these books, Exhibits V to V-7, that I testified about. There was none of those pistons in those books that referred to anything other than the six slot pistons. There is no reference in the books to one kind of piston, as distinguished from another kind. I am not testifying what kind of pistons those items mean, from my recollection; we were licensed, under Mr. E. C. Long's patent, for this particular design, and nothing else. There is nothing in these books to say what kind of piston it was, further than our agreement with Mr. Long, which—I have not got the agreement with me now—will state the design of the piston. The books don't say anything further than these were pistons we actually were to manufacture under the—.

XQ. 151. I understand that. You argue from what you claim about that, that that is the only piston you made, and that is what the books mean? **A.** Yes, sir.

XQ. 152. But that is not what I am asking you. **A.** Well, we were not allowed to make anything else.

XQ. 153. People sometimes make things they are not allowed to make. **A.** We couldn't, in this case, because our contract bound us to it.

(Narrative continued) I have no independent recollection of having seen any of these entries, regarding these pistons, made in any of these books. I couldn't point out any particular time that I seen one there.

Our agreement with Mr. Long licensed us to make pistons on any design he had made up to that time, but it doesn't allow us to make anything, and improvement that he may have done afterwards. I don't think we were licensed, under that agreement, to use any of his inventions and improvements in aluminum pistons, that he had made up to the time of the agreement. My recollection is that it was limited to this particular six slot design.

XQ. 158. But you would not be willing to say that it was not broad enough to cover such designs as shown in Patent No. 1,489,499, that I showed you? **A.** Yes, it was.

XQ. 159. Well, now, you want to change your testimony. You said a minute ago that it was limited to the

six slot piston; now you say it was broad enough to cover— A. I misunderstood the question, but we were confined to the six-slot piston; that was the object of making a drawing for every piston pattern that I had made.

XQ. 160. You say it was limited to the six slot piston? A. That is right.

XQ. 161. And did not include anything such as shown in Patent No. 1,489,499? You could not have made that if you wanted to, under that agreement? A. No, sir.

XQ. 162. Your license did not give you the right to do that? A. No.

XQ. 163. You are certain of that? A. I am certain of that.

XQ. 164. You would say that that agreement contained no such licensing clause as the following: "The party of the first part (that is, E. C. Long) grants unto party of the second part (that is, M. K. Weems) the right and license to make, use and sell for use in engines, automobiles, and motor vehicles, pistons embodying the invention and subject-matter of each and all patents now owned by him and of all patent applications now on file, whether allowed or not"? You say that agreement contained no such broad license clause as that? A. That is all right; that is in the agreement all right, but afterwards he confined us to this particular piston.

XQ. 165. When did that take place, afterwards? A. Well, that was immediately after the transaction was made.

XQ. 166. That is, you are trying to say there was another agreement that limited you to the six slot piston? A. Well, I don't know whether it was a verbal agreement or whether it was a written agreement.

XQ. 167. But you say there was another agreement, in addition to the main agreement? A. The agreement that Mr. Long and Mr. Weems and myself had at the time, that he would not allow me to make a pattern for a piston, without making a drawing, without sending it to him first. That was the object of these tracings that we have here.

XQ. 168. But you don't deny that what I read for you was in the original agreement? A. No, I don't deny that.

Mr. Richey: That is ill.

RE-DIRECT EXAMINATION by Mr. Bruninga.

(Narrative continued) I have an original of the Weems agreement, at Quincy. I knew about the agreement at the time it was made—the agreement was read over to me by Mr. Weems at the time.

I saw the agreement after it was signed, and I know Mr. Weems' signature. The agreement you have handed me (marked for identification "Defendants' Exhibit X") is the one about which I have been testifying, and that is Mr. Weems' signature. I will let Mr. Richey and yourself see my copy of the agreement, the original agreement, any time you want to see it.

Mr. Bruninga: With consent of counsel, I offer in evidence a photostat copy of that agreement, identified by the witness, as "Defendants' Exhibit X."

Mr. Richey: We make no objection to the introduction of a copy, if we can have access to the original, and can correct any errors that may be found in the copy.

Mr. Bruninga:

RQ. 8. In Mr. Richey's cross examination, with reference to the Mohrenstecher car and the pistons that you took out, he asked you a question whether it was not a double evil affair: Was there anything the matter with those pistons you took out?

(Narrative continued) There was nothing particular the matter with the pistons; it was mostly all the cylinders. Only one of the pistons in particular was scored. That was scored at the top of the piston. To my recollection, none of the skirts of those pistons were scored. I have seen good pistons get scored in automobiles, on account of something else than construction of the piston; lots of them. Lack of oil is the principal cause of scoring—and untrue cylinder walls.

Weems made no other pistons at all except the six slotted web Long pistons—not from the beginning of his business up to, I will say 1925, he handled a few solid type, such as used in the Reo cars.

When I stated that in 1920 Weems made one thousand pistons, that was from memory; that is just a guess. We slowed down in 1923, I think, more than anything else, from the lack of advertising, and then, we didn't get as much of the grinding from that time on as we got before. The result of it was we couldn't furnish the

amount of pistons for that work. I don't know whether there was any patent trouble, but I don't think so.

In 1920 Walker M. Levett made a piston casting that he shipped to any one and every one that wanted it. That piston was turned up and slotted afterwards. It was slotted with just one slot down the side, the extreme length of the skirt of the piston. I have seen some of those pistons, and know they were successful. They were not slotted singly, like one of the slots in Exhibit B; the slot extended from the lower ring land of the piston, the extreme length of the skirt. There was just one slot. That is all I remember about piston types in 1920. Those pistons was in continuous use right straight along up to the present time. We had nothing to do with any other piston in 1921, except that single slot skirt piston. As for 1922, we never had any further dealings with any other piston except the Long type piston and the piston slotted with the single slot on the side. There was other pistons made, but we never had anything to do with those.

Outside of furnishing me with the original drawings, no one helped me to make Exhibit O. I put in the lines indicating the slots—the ribs connecting the side wall of the piston to the wrist-pin boss. That drawing was made to show that just by adding two ribs, adding the ribs extending from one piston wall to the other, the piston could be slotted in six slots and still stay together. That piston, Exhibit O, with the red line on it, was very similar to the piston that I saw when I came to Long. It was no different, further than different dimensions, was all. There were different cars.

I do not know William Verner, and have never talked to him that I know of. Nor have I talked to Mr. Stallman, nor to Mr. Long since I have been here. You never told me to talk to any one, but not to talk to any one. You did not tell me not to talk to these particular attorneys here. I don't know whether you told me not to talk to any parties who might be called as witnesses.

Mr. Mohrenstecher is in Quincy now. He is bedfast and has been for probably a year. He didn't bring the car over. They just brought the cylinders and the old pistons and rode to the place. I took them back.

As to the kind of piston Ford was using in 1920, 1921, and 1922, Ford never put in anything but cast iron pistons in the model T Ford. We sold Ford pistons. We sold Ford the pistons complete for one dollar and a quarter.

When I came to Long in December, 1918, the six-slotted web piston I saw there at that time was identically the same as Exhibit F. The piston that I took out of Mohrenstecher's car—the inside of it—was identically the same as this drawing shows here, but this shows a U-slot on both sides of the piston. But the piston that was taken out had a U-slot on one side and a T-slot on the other side.

When Mr. McCoy and Mr. Watts came over to see me at Weema, in Quincy, they did not ask for any books. I was not in the habit of showing the books to visitors. They didn't ask to see the core boxes. They looked at the pistons that were in the machining process and that is what I thought they were interested in, was the process of machining. I was not particularly in the habit of showing all our core boxes to visitors, in those days, but I had no secrets. When they would come along and ask me anything about those things, I would tell them.

(Witness' attention is called to the following statement in "Defendants' Exhibit X"):

"It is understood that the following named articles are reserved to the party of the first part and not included in this sale, to-wit: One oak filing case, one electric ceiling fan, one Underwood typewriter, one old-fashioned mahogany table, one Burrough's adding machine, one special metal core box for Franklin pistons; also, other core boxes and patterns, as follows; for my patent pistons: One core box and pattern for Packard cars; one core box and pattern for Holmes car; one core box and pattern for Northway Motor Company; one core box and pattern for Overland Company; one core box and pattern for Maxwell car; one other special core box for Franklin pistons, and one three horse power Fairbanks Morse Company electric motor."

Those particular core boxes was the one we were making up here—"Defendants' Exhibit Q." We were making that core box at that time, and that particular core box, Exhibit Q, was reserved in this agreement. The core box and pattern for Packard cars was a similar type to the metal core box, Exhibit Q, but Packard dimensions, of the same construction. The core box and pattern for the Holmes car was also the same construction, as was the one for Northway Motor Company. The core box and pattern for the Overland Company was the same

that you have right there—the wooden pattern, Exhibit P. The one for Maxwell was also the same as Exhibit P. The special core box for the Franklin pistons was another experiment he was making at that time. I would not make an attempt to describe that, because I might be off on it. It is not included in any—I have that core box up there, but I would not attempt to describe it.

Mr. Bruninga: That is all.

Re-Cross Examination by Mr. Richey.

I don't know just what piston you have reference to, when you speak of the Levett piston. We got some of the pistons Levett made around 1919 or 1920, that had a single slot in them, because the trade demanded them and we didn't make them in the six-slot pistons, and so we had some of those pistons shipped in to us. And then we sold them. We sold them only as re-sale pistons; we didn't machine those. We sold various pistons as resale pistons, but no other aluminum pistons. Regarding the clearance we gave these Levett pistons when we put them in a car, we went according to the Levett's engineer's instructions on that, and if I remember right, their usual clearance was about one one-thousandths of an inch. What I mean by that, one-thousandth in diameter to each inch diameter; like a piston would be three inches in diameter outside, we would naturally give it three thousandths clearance. That is, three thousandths on the diameter. The diameter of these Franklin pistons here is three and a quarter, and we gave them a clearance of about two and one half thousandths. The Franklin Company gave them a clearance of three.

We substituted a good many of these aluminum pistons for iron pistons. They are better than iron pistons for the reason that the piston is so much lighter. It makes the engine operate with less vibration, and you can say a lot of things, but that is one of them. One of the big advantages to an aluminum piston, in case you would—the piston fit a little close and it would score the cast iron piston, it would score in the center as well as the piston wall, and the aluminum piston might score the piston, but would not injure the cylinder wall. Another thing, it was a better conductor of heat; the heat would go through the whole piston instead of—the head of the piston would become red hot, when the skirt would be practically cold in the iron piston. Carbon would deposit on the head and underneath the head, too. I have seen

carbon under the head, that would be one-half inch thick. We didn't have that trouble with the aluminum pistons. That is all of the advantages of the aluminum piston over the iron, that I can think of right now.

I testified before that we relieved all of these aluminum pistons, that I made when I was with Long or Weems, around the wrist-pin holes. I also testified in the interference of Frank Jardine and Ferdinand Jehle v. Elmer C. Long, No. 56,161, at Detroit, Michigan.

RX. 22. In that interference, did you not testify as follows:

"Q. 47. Will you tell us what you remember about this piston, speaking of the time when you were working for Mr. Long, in Quincy? A. While Mr. Long was at the Franklin factory—on his return—he gave me a blue-print of the Northway 8-cylinder motor—as to size. I took this print and changed it to our particular design, which is so constructed that the skirt of the piston is not robed inside. In other words, the piston was larger through the wrist-pin hole than the thrust side of the piston. The object of this was to do away with relieving the piston. This I took to the pattern shop and had patterns made for it. Later the piston was sent to the W. M. Levett Company, of New York City, and there was a number of piston castings ordered—more than what we needed for the experiment. This was in case of a defective casting or if one was spoiled in making. The pistons were later machined and shipped out to the Northway factory."

I show you the printed record in that case, and ask if you did not testify like that.

(Narrative continued after witness examines printed record.)

Well, of course, on that particular piston—I have had that in mind all through this examination. It was only one of the pistons that we sent to the Northway factory. But I did testify that way. I don't remember what the date was that Mr. Long was at the Franklin factory. He went down there several times while I was working for him. He was at the factory several times, but I would not say it was one or two or a half dozen.

Mr. Long did not submit any other designs of pistons to me after he left Mr. Weems. He would come in and

show me other designs that he was working on, but I had nothing to do with those, except just to look at them. He was designing new types of pistons all the time.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

Mr. Weems never made any of those Northway pistons about which I have just testified. He never made any of those pistons with the different thickness of piston wall. I couldn't relate back just what year it was that we bought and resold those Levett pistons, but I should judge that it was—it might have been 1925 or 1926, when we got the first solid type Reo pistons. It was later than any of these books shown here. By "these books," I refer to the various Weems books that I have produced here.

Mr. Bruninga: That is all.

Mr. Richey: That is all.

Mr. Bruninga: Deposition closed.

It is STIPULATED by and between counsel, that signature of the witness to the foregoing deposition is waived.

At this point a recess was taken until 1:30 o'clock P. M.

JAMES V. SAXTON, called as a witness on behalf of the Defendants, having been first duly cautioned and sworn, deposes and says as follows:

DIRECT EXAMINATION.

My name is James V. Saxton, and I am 66 years old. I am staying temporarily at 1237 Chouteau Avenue, St. Louis, Mo., and at present am unemployed. I cannot give you the exact date when I started working with A. Gilbert & Sons Brass Foundry, but it was in April, 1916. I worked there up to the time they went into bankruptcy, November 17 or 18, 1931.

I originally worked in the Machine Shop, kept track of the finished stock, and kept track of the castings that were sent there to be finished, assembled them and delivered them to the Shipping Room. That was what I started on. Then they discharged the pattern clerk and put me in charge of the pattern room. That was in

August, 1917, about the middle of August, I think the 14th. I know it was along about the middle of August in 1917.

Gilbert was doing casting of all kinds of metal—brass, bronze, aluminum; making solder, copper castings, aluminum castings. I cannot say that Gilbert was casting aluminum when I went there; he was casting aluminum when I became pattern clerk, to the best of my recollection. When I left Gilbert's, I presume there were about 30,000 patterns in that place, scattered all over the place. That is an estimate; I am not positive of that.

I was the pattern clerk, from 1917 on, had sole charge and kept the records. (Witness' attention is called to pattern marked D8764.) I recognize this pattern; it was obtained at A. Gilbert & Sons Brass Foundry Company, 4015-17-19 Forest Park Boulevard, St. Louis, Missouri. I know what bin it came out of; I got it out of the bin on the day Mr. Fletcher and I went out there. It was recently—the day I came to see you and we went out—I can't recall just the exact date. It was last week, to the best of my recollection.

I recognize this photostat, Defendants' Exhibit GG, D8764. It is in my handwriting, and was made out by me. This paper corresponds with the pattern you just exhibited to me; I obtained that pattern last week at Gilbert's, out of a certain bin there.

(Mr. Bruninga offers in evidence "Defendants' Exhibits GG and GG1." Also calls witness' attention to a photostat marked Defendants' Exhibit HH and which bears Pattern No. A640.)

I made out this paper while I was pattern clerk. The various dates under "Dates Received" on Exhibit HH designate the dates they came into the pattern room. "Dates Returned" designate the date they were returned to the owner. I made those entries at the time the patterns were received and returned respectively.

(Witness' attention is called to pattern marked "A640," "Defendants' Exhibit HH1.")

I recognize this pattern as one I obtained from A. Gilbert & Sons Brass Foundry Co. I found it in bin 398, last week. I cannot state positively the date. It came from the same bin as Exhibit GG1, and I got it at the same time. Pattern HH1 corresponds to the pattern noted on HH.

(Mr. Bruninga offers in evidence "Defendants' Exhibits HH and HH1." Also calls witness' attention to the photostat marked for identification, "Defendants' Exhibit II," and bearing pattern number B122.)

I made out this paper while I was pattern clerk at Gilbert's. The two patterns marked "B122," Defendants' Exhibits III and II2, which you call to my attention, were obtained by me at A. Gilbert & Sons Brass Foundry Company, out of bin 398, last week. The two patterns, Exhibits III and II2 correspond to pattern No. B122, or Exhibit II.

(Mr. Bruninga offers in evidence "Defendants' Exhibits II, III and II2.")

I made the sketches on Defendants' Exhibits GG, HH and II, when I got the patterns the first time. The dates under "Dates Received" signifies the time I received them in the pattern room, and "Date Returned" signifies the date I returned them to the owner. The "2" with the ditto mark immediately under "Date Returned" signifies that they were made at A. Gilbert & Sons Brass Foundry Company, and they are duplicates of the owner's original pattern—exact duplicates.

On Exhibit GG, "1 wood—C. B." signifies that one wood pattern and one wood core box were returned that day. On Exhibit HH, "1 wood—1 C. B." signifies one wood pattern and one wood core box owner's pattern and core box, were returned. Under "Date Received" of "2-22-19" on Exhibit HH, "4 wood—1 C. B." means there were 4 wood patterns and one wood core box received on that date here (indicating).

On Exhibit II under the date of 2-22-19, "1 wood—C. B." designates one wood pattern and one core box received. Under date of 2-21-19, "1 wood—C. B." designates one wood pattern and one wood core box returned to owner.

(Witness' attention is called to paper, marked for identification, "Defendants' Exhibit JJ" and marked "Pattern No. H4.")

I made this sketch the date it was received, October 10, 1919. Under "Special Identification," "1 wood" designates one wood pattern and one core box. That includes a core box; it is marked under "number of core boxes." I do not know where that pattern is now. The date 1-28-20 indicates the date it went back.

(Witness' attention is called to paper marked for identification, "Defendants' Exhibit KK," bearing pattern No. C123.)

I made out this paper while I was a clerk at Gilbert's, and I made the sketch on it. "1 wood" indicates one wood pattern and one core box. The core box is designated under "number of core boxes." "4 wood—1 C. B." designates 4 wood patterns and one core box. "1 wood—1 C. B. 3-21-19" designates 1 wood pattern and 1 wood core box returned.

(Mr. Bruninga offers in evidence "Defendants' Exhibits JJ and KK.")

I made the drawings on Exhibits GG, HH, II, JJ and KK from the owner's pattern. I also made out the card marked Defendants' Exhibit LL. The number under the pattern number is B640. The designation on the card "Use pattern A640 as per instructions on core box" refers to, use this core box for pattern A640. Regarding the relation that A640 pattern has to Defendants' Exhibit HH1, that is the core box they constructed for use on pattern A640.

Exhibit LL bears the date under "Date Returned" of "3-21-19"; that designates that core box was returned to the owner on the date. The card was obtained from A. Gilbert & Sons Brass Foundry Company, but I do not know who obtained it; I did not take it from the files.

(Mr. Bruninga offers in evidence "Defendants' Exhibit LL," and hands witness a card marked "Defendants' Exhibit MM," which bears the pattern number A641.)

I made out that card, and it refers to one pattern and one core box. I do not know what "Andy Watson, 1104 Chemical Bldg." refers to; it is not in my handwriting. The date "4-8-19" on Exhibit MM refers to the date the pattern and core box were received.

The designation "E. C. Long Mfg. Co." on Exhibits GG, HH, II, JJ, KK, LL and MM, refers to the firm owning the patterns. I have met Mr. E. C. Long. I know I met him once at the time of the transactions of these various Exhibits that I have testified to. I can't recall the exact date, but it was a number of years ago. It was in connection with those patterns I have talked about, and he came into the pattern room and wanted them cast as soon as possible.

Mr. Richey: I object to the part of the answer that says what Mr. Long wanted as being incompetent.

(Narrative continued) I don't recollect ever seeing a core box like Defendants' Exhibit P, which bears a plate on the back marked "0.13." I could not say positively that I have never seen that particular core box before. I can't say whether I recollect seeing a core box of that construction before, nor could I say how many patterns went through my hands from 1916 to 1931; there were thousands of them.

The core boxes that are referred to in the various Exhibits GG to MM inclusive, have been returned to the owners of the patterns. I do not know where they are.

Direct Examination closed.

CROSS EXAMINATION by Mr. McCoy.

Referring again to Exhibit HH, one pattern was received from the owner and one received from the pattern room—Gilbert's pattern room. I can tell whether the pattern came from the owner or from Gilbert's pattern room. This one is Mr. Gilbert's (witness indicates word "Gilbert" as a special identification). This card indicates that on January 16, 1919 there was one of these patterns returned to the owners. Four wood were returned on March 21, 1919. The card indicates that the Gilbert pattern was left with the foundry and remained with the Gilbert Company after March 21, 1919. As to my independent recollection of the character of that pattern: The Gilbert pattern is a duplicate of the original pattern—an exact duplicate in every respect.

I do not know what the core box looked like that was originally received by Gilbert. I also do not know what the core boxes were like that were received as I have testified as indicated on Exhibits II, JJ, GG, KK, and have no independent recollection of the nature of the core boxes about which I have testified in connection with Exhibits LL and MM.

(Witness is asked to examine Exhibits HH to MM, inclusive, and tell which of the various patterns and core boxes indicated in these Exhibits remained with the Gilbert Company, and which are indicated as returned to the E. C. Long Company, or the party supplying the pattern.)

E640 was returned by Gilbert; that is Exhibit HH. E122, Exhibit II, two wood, retained by Gilbert; H4, there was no duplicate made on that. JJ was returned; D8764, Exhibit GG, one wood pattern retained by Gilbert—their pattern; C123, Exhibit KK, one wood and one core box returned February 6, 1919. There were four wood (I can't tell that date) four wood and one core box returned, March 21, 1919.

Referring now to Exhibit LL, the card indicates that that core box, No. B640, was returned to E. C. Long. That is the date the core box was returned—March 21, 1919. Regarding MM, that pattern was returned, but the card does not show what date it was returned. I know it was returned because it was not in the bin when I cleaned out the bin out there.

Since the time of its receipt on January 29, 1919, pattern D8764 has been in the possession of A. Gilbert & Sons Brass Foundry Co. The last time I saw that pattern prior to the time I located it last week for Mr. Bruninga, was at the time the castings were made and when I put the pattern away. I can identify this particular pattern, Exhibit GG1, as the particular pattern I saw at that time, because I made these numbers with an embossing machine, numbered and marked on here (indicating). That is my painting. I put that on Gilbert's pattern so there would not be any possible chance that this pattern would be returned to Long.

I don't know who obtained those cards about which I have been testifying this morning, but Mr. Fletcher inquired of me about these patterns last week, to the best of my recollection, when he and I went to the Foundry. I had not examined those patterns during the intervening time from 1919 and the other day when I looked at them.

Mr. Richey: You agree that that was Herbert G. Fletcher, who was attorney in the Long Interferences?

Mr. Bruninga: Yes.

(Narrative continued) These various patterns were used for making piston castings. I know enough about the foundry business to know that they were used for that. I recall using those particular patterns for making piston castings. That was on the card, at the time of receipt. That is not a deduction from what I see on the card; that is my recollection for the reason that we re-

ceived those patterns from Long with an order. My orders came from the office and usually the patterns were received with the orders and I got the order and marked up the casting card, stated how many castings were ordered, with such aluminum, and pattern number on it, and the casting card designated how many patterns and how many core boxes.

I did not make any of those patterns myself; the pattern maker made them. These records indicate what the patterns were used for. Insofar as the pattern record cards show, there is nothing to show they were used for making piston castings. All they do is make a cylindrical hole in the sand. It could be used for anything that would require that type of cylindrical casting cavity.

I was not asked to make any search for exhibits of this nature prior to the time that Mr. Fletcher inquired of me, a week or so ago. The first time I saw Mr. Fletcher he called me up; I can't just recall the exact date now. I have a little memorandum in my pocket he called up down there where I stay, and I did not put any date on it. I just put, Fletcher, 302 Title Guaranty Building. I can't state positively how long ago that was; it might be a week and it might be a little over a week. It is recently. That is the first time I ever saw Mr. Fletcher, to the best of my recollection.

I do not remember your coming to me and asking me for these pattern cards several years ago. I do not recollect getting out any cards for parties who inquired for them regarding the E. C. Long matter several years ago.

The cards shown in Exhibits HH, II, JJ, GG and KK came from the A. Gilbert & Sons Brass Foundry Company. I know because I recognize my handwriting and drawing. That is the only way I can tell, however. I may have got the cards out that are shown in Exhibits HH, II, JJ, GG and KK, but I don't recollect getting them out. However, I would not have removed the cards unless I had orders from the office, from Charles F. Gilbert, the President. I don't recollect Mr. Gilbert's asking me to get the cards out. He may have done so.

I can't say why the remaining cards LL and MM were not produced at the time of the production of Exhibits HH, II, JJ, GG and KK. To the best of my knowledge and belief, cards LL and MM came from A. Gilbert & Sons Brass Foundry Company, but I don't know who got them, or when they came from there. I recognize the

cards that remain in my handwriting—that's my handwriting (indicating). I don't recollect ever getting those cards, HH, II, JJ, GG and KK, out of the company records. I have no recollection of taking those cards out, but it is just possible that I did. I can't recall it now.

Cross examination closed.

RE-DIRECT EXAMINATION.

I placed the word "Gilbert" on Exhibit GG1, and the words "Gilbert Patt." on Exhibits HH1, II1 and II2. They designate made and owned by A. Gilbert & Sons Brass Foundry Company. I found those patterns in bin 398 and at the time I was out there with Mr. Fletcher. I knew without consulting any records what tin I could find them in from memory.

I know what a pattern for a piston looks like.

RDQ 9. Do Exhibits GG1, HH1 and II2 look like piston patterns?

Mr. Richey: I object to that as calling for a conclusion and as being immaterial.

(Narrative continued) The yellow painted parts on these patterns are core prints.

Re-direct examination closed.

RE-CROSS EXAMINATION by Mr. McCoy.

Regarding my search with Mr. Fletcher for these records, when I got out there they had a man in charge of the place and he did not seem to know anything about these patterns and I knew that some patterns made for Long, which belonged to Gilbert were still out there, then Mr. Gilbert himself came and I asked him if we could go in there. I also asked a young man who was in charge of the place under the Trustee whether I could go in there and look for patterns. He said yes, you can go in and I went direct to the bin where they were stored and I took my man from the floor, and Gilbert says, yes, those are the patterns, if Mr. Fletcher wants them give them to him, he did not care about them any more. Mr. Fletcher and I took them down town to his office then. There were none in that bin when we got there that belonged to Mr. Long but we produced all the patterns that were made for Mr. Long—all that we could find in that bin. We did not search any other bins; I had no recollection of any other bins.

That bin would contain all of the patterns that were made for Mr. Long by Gilbert Company in 1919, but there were patterns belonging to other people put in that bin since that time and there would not be sufficient room to put in all the patterns that we ever received from Mr. Long. I don't think the bin would have been big enough. It may have been at that time. They were crowded for room out there and there were more patterns coming in than going out and they were crowded and I put patterns in whatever bin I could find any space for them—in any bin that had sufficient room. Yet I did not search any of these other bins for patterns at the time I was out with Mr. Fletcher.

Re-cross examination closed.

Mr. Bruninga: Counsel understands that Mr. McCoy has the originals of Defendants' Exhibits GG, HH, II and KK and he is requested to produce same.

Mr. Richey: In answer to that, we will say we will produce them if we have them. We would have had them here today had we been notified in time to bring them along.

Mr. Bruninga: I did not know that Mr. McCoy had these originals or I would have asked him to produce the same.

Deposition closed.

Deposition of CHARLES F. GILBERT, taken in behalf of defendants, by consent of the parties, at 4069 Park Avenue, St. Louis, Missouri, on the thirteenth day of May, 1932.

CHARLES F. GILBERT, a witness of lawful age, being duly produced, sworn and examined, testified in behalf of the defendants, as follows:

DIRECT EXAMINATION.

I am Charles F. Gilbert, of St. Louis. I am 54 years old, and in the brass foundry business. We are a company at present, Gilbert Brass Foundry Company. Formerly, it was A. Gilbert & Sons Brass Foundry Company. Our present company is located at 4069 Park Avenue; the A. Gilbert & Sons Brass Company was located at 4017 Forest Park Boulevard. It was in that location from 1907 up until the present time. It is liquidating

now; it has not finished. It is a trusteeship, and was a corporation. I was President and Treasurer of that Company. I would say I still have relations with that Company, until it is completely liquidated. I have no control over the assets of that Company; it is in the trustee's hands. Karl Korngold is the trustee, and it went into trusteeship on November 19th, 1931.

I have none of the records of that Company, the A. Gilbert & Sons Brass Foundry Company, that I know of. The records of the old Company are in Karl Korngold's hands. I had access to them as long as the—just prior to the time at which we moved everything, which we purchased; not now, I have not. To the best of my recollection, I think I made a search of the records of that Company, with reference to transactions with Elmer C. Long, in 1926 or 1927. I am not sure just exactly what year it was. I made that search for Mr. Fletcher. I don't remember whether I made any for Mr. McCoy or not. His face is very familiar. Probably I did.

Mr. Richey: We agree that he did, and also it is agreed that Mr. Fletcher is Harbert G. Fletcher, attorney for Mr. Long, in those interferences.

Mr. Bruninga: That is right.

(Narrative continued) James B. Saxon was our pattern clerk in that Company, beginning, I would say, from along about in 1912 to 1931. He was with us up until we went into receivership—into trusteeship. He had charge of the pattern records and pattern room.

(Witness is handed photostats, "Defendants' Exhibits GG, HH, II, JJ and KK.")

The handwriting on these records is James Saxon's, and this is a photostat of a pattern record of the A. Gilbert & Sons Brass Foundry Company. I don't know whether I got them from Mr. McCoy or whether I got them from Mr. Fletcher or Mr. Long; I am not sure which. It has been some time ago. But I got them from one of them. I got the originals out of the records of the Gilbert Company.

(Witness' attention is called to "Defendants' Exhibit LL.")

I recognize that as a pattern record of C. E. Long, or E. C. Long, and it came from the pattern record of the A. Gilbert & Sons Brass Foundry Company. I took

it out of the records two or three weeks ago, and gave it to Mr. Fletcher.

(Witness' attention called to "Exhibit MM.")

This record I also took out of the records of the Gilbert Company and gave to Mr. Fletcher. I have not examined the records of the Gilbert Company to find any additional records of transactions with Long or with Mr. Long's Company, because that was all the card records that was left, and all the books are in the care of the trustee. I never had any access to the books.

I would say there probably are additional records, I don't know where you would be able to locate them now. I have searched for them, in the last couple of weeks. We had them in 1926, and I searched for them at that time. Exhibits GG to KK, inclusive, were turned over to them at that time. To the best of my recollection, that is all I could find at that time.

I should say that the books of the Gilbert Company, that show the names of the employees from 1916 to 19— have been destroyed. We never kept those records after five years. That is my best thought right now. I would say the records from 1914 to 1922, were destroyed; I haven't any. I do not know of any other records relating to the Long transactions with the Gilbert Company, unless the records—ledger sheets that have been transferred could be located, which are now in the hands of the trustee. I don't know where he has got them. As to the records dating back from 1916 to 1920, I would say they are all gone.

The location of the office of the A. Gilbert & Sons Brass Foundry Company was 4019 Forest Park Boulevard. It was there in 1926; prior to 1918 it was in a flat at 4019 Forest Park Boulevard, in a different building. It was a flat with the number of 4019 Forest Park Boulevard, up until 1918 or 1919, when we tore it down and built offices and moved our office to the second floor, that is, 4019 Forest Park Boulevard. The office was in the former location from about 1912 to 1917. After 1917, the flats were demolished and a new building was built, and the office was located in the second floor, 4019 Forest Park Boulevard.

I knew Elmer C. Long at that time. It has been a few years since I have seen him. When I first met him he was located in Hannibal, and later in Quincy. I saw him both at Hannibal and Quincy. I called on him and solicited his trade in both places.

When I called on him in Hannibal he was running a machine shop and making automobile parts. He was working on an aluminum piston at that time. The record here will show the type; the same thing—the same line as these records GG to KK show here, with exception of changing the core box from time to time.

I saw the pattern of the piston he was making when I saw Long in Hannibal; pattern and core box. The core box was a wood box, solid pattern, which was for the piston casting, which left ribs in the casting to strengthen it—left ribs on the inside of the casting. I don't recall how many ribs there were.

I can't describe that core box more fully other than that it had ribs in it, that is, it was made in such a way that it would leave the inside of the piston casting with ribs, which would leave a hub for the piston pin to work in, and ribs to strengthen it on the sides. The ribs couldn't be fastened on, because they had to be loose in there.

Mr. Richey: The answer is incompetent, a conclusion of the witness, and argument.

Mr. Bruninga:

Q. 76. You saw that core box, did you not? A. Yes, I did.

Q. 77. Did you see the parts in the core box, that made the ribs? A. I did.

Q. 79. Give me a complete description of the core box. A. In the making of a casting of that character, in order to core it or make it hollow, leaving those ribs in there, the ribs in the core box would have to be loose within the core box, so they could be withdrawn before the core is put together.

Mr. Richey: I want to object to it. I object to the answer as the witness' conclusion, and argument.

Mr. Bruninga:

Q. 80. What Mr. Richey wants to know is not what you think it ought to have, but what you actually saw that it did have. A. Well, it did have. It couldn't be otherwise.

Mr. Richey: Same objection.

(Narrative continued) I was familiar, at that time, with the core for an ordinary trunk piston. Such a core for a trunk piston had provisions for that kind of ribs,

extending across from each side of the core box. The piston casting, as made from the pattern of the core box furnished us by Long, left a hub in the upper portion, in the upper one-half, the solid end one-half, where the piston pin works in, and four ribs probably dropping down to about the same distance or a little further than the hub of the piston. Those ribs run from the inside of the piston wall to the piston hub, crosswise of the piston; no, not crosswise; it would be lengthwise in a piston. Those ribs connect with the hubs, and they extended from the hubs to the inside of the wall of the piston, to the skirt and head, both, as I remember it. It was attached to the head of the piston and to the sides of the piston.

We cast pistons for Long of that construction. I don't think it was prior to the time that I saw him in Hannibal. I think the time I made connection with Long was the first visit I made on him in Hannibal. That was along about 1912. We fooled around making piston castings from 1912 up until, I think, around 1919 or 1920.

Q. 94. Aluminum pistons?

Mr. Richey: I object to that question as leading.

A. Aluminum pistons.

Mr. Bruninga:

Q. 95. Did your company make any—cast any iron at all? A. None whatever.

Q. 96. What did you cast? A. Aluminum, brass, bronze.

Q. 97. You saw pistons at Long's the first time you went over there?

Mr. Richey: That is objected to as leading.

(Narrative continued) Not that I remember. What I saw was a pattern. That is my recollection. I did see some of Long's pistons complete. Just exactly when I couldn't say, because after he machined them up and experimented with them, if I remember correctly, at one time he was making them for the Franklin Automobile Company, and he brought some of the pistons back that we had made; whether it was for—I think it was due to excessive wear on them at that time—and wanted to know if we couldn't make a different composition of aluminum that would stand up better in service and we—if my memory serves me right, at that time were experimenting with a metal which we developed after—

wards, called aluminite, and from which we made some piston castings for Mr. Long and they gave much better service; that is to the best of my recollection. I prefer to keep the composition of that aluminite secret. We were using standard No. 12 at that time, in the original castings. No. 12 was supposed to run approximately ninety-two aluminum and eight of copper.

I stated that the best of my recollection was around 1912 that I first made piston castings for Mr. Long. Those pistons were for automobiles, and their construction was as described a few minutes ago, in the testimony—the ones with the ribs.

The year before the United States entered the war, the Gilbert Company was doing just a general brass foundry business. They did not work on munitions prior to the entrance of our country in the war. We did make aluminum piston castings for Mr. Long before the United States entered the war; from 1912 to 1917. We made them off and on, two and three times a month. They were of an experimental nature; nothing in the way of production. There were a half dozen or so at a time. This was on a credit basis, from the very beginning.

Up to a couple of weeks ago there were patterns for the Long pistons in the Gilbert Company place. I know because I went down and looked over the records and found two or three of them. I don't remember what bin it was. The card record, which was turned over to Mr. Fletcher, will show that. Those two cards were all that were turned over to Mr. Fletcher.

I saw those piston patterns myself before Mr. Fletcher took them out. There was someone with him, that located them—a pattern clerk, Fred Eyerkuess. Yes, Mr. James B. Saxon was there. He came there with Mr. Fletcher.

I think I would recognize the patterns. (Witness' attention is called to "Defendants' Exhibits GG-1, HH-1, II-1, and JJ-2".) Those are the patterns that were turned over to Fletcher. They were obtained from the Gilbert Company's place on Forest Park Boulevard, about two weeks ago. I have seen those patterns before; quite a few years ago. They are patterns for piston castings.

The yellow part on the end of these is the core print—the core box goes with that core print. Core boxes of that time were not located. I don't know where they are. They were the type core box which sand is packed in, that hollows out the inside of the pattern or casting,

to make it hollow. I don't remember particularly a core box for Exhibit GG-1; I remember that all of them had a core box with them. A core box, as I have stated, with the core print on the pattern coincides or fits the core box and the core is made in such a way that sand, when inserted, can drop down into the core print on the pattern, and when the casting is cast it leaves the casting hollow; and those core boxes had ribs on the inside, with also a lug where the—which formed a hub. I think there was one hub, or wings extending out from the hub, which made four divisions in the casting.

There is one hub in a piston, and it is used as a drill, to insert the piston pin. I would say the hub is located about one-third the way down from the top, at the closed end of the piston; in the center, from wall to wall.

(Witness' attention is called to "Defendants' Exhibit P.")

I have seen this core box before; as to whether there has been use made of it in any—whether we made any use of it or not I couldn't say just now.

Q. 141. What relation does that core box, Exhibit P, have to Exhibit GG-1, if any? A. The core box which makes the core, that you make the core in, and hollows out the pattern.

Mr. Richey: I object to the answer as incompetent.

(Narrative continued) I have been in this foundry business thirty-one years. I think I know a little bit about it; considerable about it. I absolutely was able to answer the last question.

Q. 146. What is the relation of the core print, of Exhibit GG-1, and the core box, Exhibit P?

Mr. Richey: That is objected to as incompetent.

A. The core print is a guide to insert the core in the mold and hold it in place.

Mr. Bruninga:

Q. 147. Do they fit or don't they fit? A. They do fit.

Q. 148. One is made for the other, is not that right?

Mr. Richey: That is objected to as incompetent.

A. One is made for the other.

(Narrative continued) We have recently made cores with Exhibit P, in this place. We made some yesterday, to make a casting from the pattern; this pattern here (indicating). We have some of those castings—Exhibit GG-1—on the floor right now; we can produce one of those castings. Here is one of the castings made from the pattern (producing casting).

This is the core box, Exhibit P. That casting was made this morning, in this place.

Mr. Bruninga: I offer in evidence this casting as "Defendants' Exhibit NN."

Mr. Richey: We object to it as immaterial. It does not matter what can be done today by using different core boxes or patterns or things of that kind.

Mr. Bruninga: —

Q. 160. From your experience, would you say that Exhibit P was designed as a core box for the pattern, Exhibit GG-1? A. I would say it was.

Q. 161. How often would it happen that the core prints would correspond, if they had not been designed deliberately for one another? A. It would be a miracle if they did.

Mr. Richey: That is objected to as a guess of the witness.

(Narrative continued) The diameter of the core print bears no relation to the casting, as far as design is concerned. The depth of the core print bears no relation to the casting, but it does to the pattern to which it was made. The core print on the core box has to correspond to the core print on the pattern, that is, the core box has to correspond to the core print on the pattern. Usually, the man that makes the pattern makes them correspond.

Comparing Exhibit P with the Long core box which I previously described, it is identically as I described it in the other statement regarding the core box and patterns. I first saw a core box like the one exhibited here, or similar to it, back in 1912, in Mr. Long's place and at our foundry on Forest Park Boulevard, afterwards, when Mr. Long sent us a pattern down to have castings made from them. Mr. Long sent one core box with the pattern, but in his experimenting, while the pattern always remained the same, he was continually changing the core box on the inside. The change was in the way the ribs were inserted, the number of ribs. I was referring to

the removable ribs P-1 and P-2 when I made the statement about the core box, changing the ribs on the inside.

I don't think I could enumerate some of those changes, other than the core box came down to us with ribs in one way, and after he got the castings and experimented with them, they were not exactly what he wanted and he changed them and had other castings made. As to what changes he made in them I don't know. The fact of the matter is, that I never paid that much attention to it, further than to make the castings for him.

If these pieces were taken out and the holes filled up, that core box would be the same as an ordinary trunk piston, except it would not have any ribs on the inside. I saw a core box similar to this core box, at Long's place in Hannibal, in 1912. It had some ribs in it; whether the ribs were inserted just as they are there or not, I can't say. I couldn't say how early I saw a core box with ribs arranged like in Exhibit P, because I don't remember just exactly when I first saw the ones with the ribs cross-wise, like that. I know it was before the United States entered the war.

The Gilbert Company made no die castings at that time, all sand castings. I say, no die castings; I experimented for years with die castings, but I have never done anything commercially with it.

That number, 0.13, is a number that was placed on there by our pattern clerk with a machine that we had for making such a number by zinc strips. From all indications, that strip was made at the Gilbert Company, because that is the way we numbered all our patterns; that is the kind of strip that was used. It was made by a machine especially built for embossing those letters on strips of zinc.

I know that a core box like Exhibit P was used at the Gilbert Company to make aluminum pistons, before the United States entered the war, for Mr. Long. As I say, we started to do business with Mr. Long about in 1912 and experimented with him on pistons from then on until '19.

We made five castings like Exhibit NN, here. We also have a core that was made with that core box; Mr. Fletcher has it.

Q. 191. Do you know whether any trouble was encountered in the making of that piston, Exhibit NN, with the pattern, GG-1, and the core box, Exhibit P?

Mr. Richey: I object to the question as asking for the conclusion of the witness.

A. None whatever.

Mr. Bruninga: Direct examination closed.

CROSS EXAMINATION by Mr. Richey.

I think this Exhibit P, the parts there were in my shop prior to 1930. I am not positive; to the best of my recollection it was. From evidence of the pattern number on it, I would say it was just like it is here—parts and all. That would include these two removable parts (indicating on Exhibit P); otherwise the core box would not be complete. To the best of my knowledge, those two removable parts, P-1 and P-2, were in my place prior to 1930; to the best of my memory it was.

I said Mr. Long came in from time to time, in getting these castings made, in an experimental way; he was continuously changing his patterns, all the time we were making castings for him. The patterns remained just as they were; the core box was changed. There was no necessity for changing the pattern. The core box he changed from time to time. He some—took the core box that he had used in making one piston and modified it and had another one made. He was constantly putting the ribs in, in different positions and different shapes.

XQ. 14. You testified before, in these interferences, did you not? A. I think I did, yes.

Mr. Richey: Mr. Bruninga, you will agree that he testified in Interferences Nos. 49,569, 49,570 and 49,571?

Mr. Bruninga: Yes.

Mr. Richey:

XQ. 15. Before you testified in those cases, Mr. Fletcher talked to you, Mr. Long talked to you, Mr. McCoy talked to you, and I, F. O. Richey, talked to you? A. Yes.

XQ. 16. And we all asked you at that time to give us your earliest dates on these pistons of Long's, did we not? A. I am not sure whether you did or not, now.

XQ. 17. Some of us did? A. I presume so.

XQ. 18. Mr. Fletcher and Mr. Long were asking you for the earliest dates that you had made any of these castings; that is correct, isn't it? A. As to its correctness, I couldn't say. To the best of my recollection, those questions were asked with reference to that.

XQ. 19. And you were also asked by one or the other of those parties to search your records, to find

records of the earliest date of making any of these piston castings for Long; that is correct, isn't it? A. I think so.

XQ. 20. And you did make searches for such records, or had them made? A. I had them made.

XQ. 21. You didn't make them yourself? A. No.

XQ. 22. Whom did you have make them? A. Jim Saxon.

XQ. 23. He searched, and then brought in to you the earliest records that he could find? A. He did.

XQ. 24. Did not Mr. Fletcher at that time, or Mr. Long, ask you when you first made piston castings for Mr. Long? A. They probably did; I don't know. If my testimony shows it there, he did.

XQ. 25. In that case you testified as follows, did you not?

"Q. Did your company ever make any piston castings for E. C. Long or the E. C. Long Manufacturing Company? A. We did.

Q. What is the earliest date at which your Company made piston castings for E. C. Long or the E. C. Long Manufacturing Company? A. October 10th, 1919.

Q. In giving this date you have referred to some cards, haven't you? A. I have.

Q. What are these cards? A. Pattern record cards.

Q. Of your company? A. Of our company."

Later, it was shown that instead of October 10, 1919, that was October 10, 1918; that is right?

Mr. McCoy: October 16, 1918.

Mr. Richey:

XQ. 26. Then you were asked as follows:

"XQ. 34. Is it possible there are other record cards referring to the patterns received from E. C. Long or the company he represented, other than the record cards you handed to opposing counsel? A. None whatever, other than the records you have.

XQ. 35. But isn't it possible that you may have overlooked some? A. No."

Now, you so testified, did you not? A. According to that record, yes.

XQ. 27. You did so testify? A. Yes, I testified.

XQ. 28. The records that you had in mind at that time, when you said there were not any others, were these records GG to KK, inclusive? A. Whatever they are.

XQ. 29. Those records were given to us after the search you had made? A. I presume they were.

XQ. 30. That is a fact? A. A search had to be made for them in order to give them to you.

XQ. 31. Now, in the same interference you testified on behalf of Mr. Long, and were examined by this same Mr. Fletcher; that is correct, isn't it? A. I think so.

XQ. 32. In this interference, when you were examined by Mr. Fletcher, you were asked the following questions:

"Q. Do you recall whether about the year 1914, or prior thereto, that you made pistons for Mr. Long? A. To the best of my memory, it was around that period, around 1913 or 1914."

That was the way you testified, was it? A. I think it was.

XQ. 33. Did not Mr. Fletcher ask you, before he placed you on the witness-stand, what kind of pistons you made for Mr. Long in 1913 or 1914? A. I think he visited our place and asked—visited Mr. Long, and Mr. Long told him where he got the pistons made, and he came out and asked. He came out and asked us if we made aluminum pistons for Mr. Long, and I told him we did.

(Narrative continued) I don't remember whether I described the pistons to him or not, or whether I showed him the patterns and core box. I may have done both. I don't remember whether he asked me, on the witness-stand, what kind of pistons those were. Possibly I did tell Mr. Long, when he asked me to tell them what kind of piston I made for Mr. Long in 1913 and 1914, that I didn't remember. I couldn't say when I last talked to Mr. Long about this piston matter. Possibly the last time I talked with Mr. Long was at the hearing; along back in there. I don't remember whether that was around 1925 or 1926. I think it was in connection with these interferences.

I would hate to estimate how many different kinds of castings my company manufactured between 1910 and 1925. Many thousands. I believe I could mention any name—I believe I could come pretty near describing the class of castings and the character of castings which I have made for customers, back from the time I started. That is thirty-one years ago. Every year there were a good many hundred, if not a good many thousand, castings under my observation, and I can even call pattern numbers for you, mechanical electric—

XQ. 43. I didn't ask you for that. Pardon me, but we just want evidence that is competent in the case.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

I have no interest whatever in this proceeding. I know what it is about. I know it is a suit pertaining to an aluminum piston—from Mr. Long and Mr. Fletcher, representing him. What the suit is about now, whether it is Mr. Long's suit, or some one else's, I don't know. In those interferences that Mr. Richey called my attention to, and I gave a date, for instance, of October, 1918, I gave that from the records. I understood I was giving it from records when I answered. The record was produced. I would say our pattern clerk made a good search of the records at that time, because I instructed him to do so. I thought the search had been made. I did not know that these two cards, Exhibits LL and MM, were in existence at that time, because I didn't know there were still any left in the files. When I personally looked, I found them.

I have spent my life in my business—thirty-one—thirty-two years. I started the business of the Gilbert Brass Company. I started it in March of 1900, and I would say that I keep close track of it.

Mr. Bruninga: That is all.

It is stipulated by and between counsel, that signature of the witness to the foregoing deposition is waived.

Deposition of SIDNEY D. ROYALTY, taken in behalf of defendants, pursuant to the annexed notice, in Room No. 1 Morrison Block, Jacksonville, Illinois, on the twelfth day of May, 1932.

SIDNEY D. ROYALTY, a witness of lawful age, being duly produced, sworn and examined, testified in behalf of defendants, as follows:

DIRECT EXAMINATION by Mr. Bruninga.

I am Sidney D. Royalty, of 231 Pine Street, Jacksonville, Illinois. I am in the automobile service business, and handle Franklin, principally. I have been in Jacksonville, this last time, since May, 1923. I am fifty-four years old. In 1910 I was working for Mr. Elmer C. Long,

in Hannibal, Missouri, selling automobiles and doing a little service work. Mr. Long was handling Maxwell automobiles at that time.

I was with Mr. Long for about a year, then I moved to Barry, Illinois, about twenty miles from Hannibal, where I went into the hardware and implement business. I was in Barry until the fall of 1916, then I moved to Quincy, Illinois, where I worked for the Electric Wheel Company, until February of 1918. On February 15, 1918, I went to work for Mr. Elmer C. Long again. I don't know of any particular way that reminds me to fix that date; of course, I had to notify the Wheel Company several days before I left them, and I just remember distinctly that it was in February, the middle of the month.

At that time, Mr. Long's place was at the corner of Twentieth and Main Street, in Quincy. Later in the summer he moved to Eleventh and Main Street. I worked for him until the fall of 1919, when he sold out to Mr. Weems, and moved away.

I continued with Mr. Weems, and I think I worked for Mr. Weems until the latter part of April, 1921. Then I came here to Jacksonville, and worked for Mr. C. N. Priest, who was handling Franklin automobiles. I did service work for Mr. Priest, the same as I did with Mr. Weems; Franklin service work.

I was with Mr. Priest until about March of the next year, then I moved back to Quincy and had a little shop of my own, during that balance of that year, 1922. The first part of January, 1923, I went to California and stayed there until the first of May, 1923, and came back to Jacksonville. I have been here ever since. When I went back to Quincy, I had a little independent Franklin Service station of my own. When I went to Barry, Illinois, in 1911, I used to come to see Mr. Long, in Hannibal. I think it was in 1913—1912 or 1913, I began to handle cars under Mr. Long, with a sort of sub-dealer's contract, and I used to see him about that.

I handled the Moon and the Oakland, through Mr. Long, and naturally I would have a little business with him whenever I would go to Hannibal.

Mr. Weems was making pistons, principally, when I was with him; aluminum pistons. They were called the Long piston; the piston designed or patented by Mr. Long. I first saw a piston designed by Mr. Long, about the year 1913, as well as I remember. While he was in Hannibal, I saw some pistons that Mr. Long had de-

signed. I was in Barry, at that time, and that happened about two years after I came to Barry, as near as I remember; that was before I left Barry.

The first piston I remember was a cast iron piston. The construction I remember mostly was slots in the piston. It had a slot resembling the letter T, on one side, and on the other side there was a letter U inverted, and this U had a slot running from the lower part of the skirt, almost half way up the skirt of the piston. That was a trunk piston with wrist-pin bearings; it was a solid—the skirt was in one piece, except for these slots. Those slots were located, with reference to the wrist-pin bearings, between them, between the wrist-pin bearings. I believe I could make a sketch of the piston I saw in 1913.

Mr. Brunnings: The sketch made by the witness is marked for identification "Defendants' Exhibit DD." I will mark on the sketch, above the first figure to the left, "Fig. 1," and on the next figure to the right, I will mark "Fig. 2."

(Narrative continued) Part "a" in that piston was the slot T; it was cut clear through the skirt wall. Part "b" in Fig. 1 is the head of the letter T; that, too, went all the way through the skirt wall. The slot, a, the best I remember, ran to the end of the skirt. I wouldn't be positive about it.

The heavy parts, c, represent the wrist-pin bosses. Line, d, represents the ring groove section. In Fig. 2, c represents a wrist-pin boss; f, represents a ring groove section; and g represents the inverted letter U. They went all the way through the skirt. I think they went all the way to the end of the skirt, but I am not positive. It has been a long time since I have seen that piston. It is a little detail that I wouldn't be sure about.

The part, h, represents the bottom part of the letter U, inverted. Part, i, represents the slot in the skirt, inside of the letter U. That went all the way through the skirt.

To prevent g and i from dropping out, there was webs on the inside, that supported the parts that were slotted. I could make a sketch to show those webs. (After making sketch, marked Fig. 3.) That is as well as I remember those webs.

In Fig. 3, part J represents the web in the inside of the piston. Part k, is a wrist-pin boss and l represents a ring groove section. I think there were two of the webs, j; one on either side. They were connected with

the piston by being fastened to the sides of the skirt. I don't remember whether they extended up into the head of the piston or not. They were cast on, and were also cast on to the wrist-pin bosses.

Mr. Bruninga: I offer in evidence "Defendants' Exhibit DD."

(Nar: I've continued) The piston as shown on Exhibit DD was shown to me by Mr. Elmer C. Long in 1913, as well as I remember. I was living in Barry at that time.

When I came to work for Mr. Long in February, 1918 Charles Chadwick was not working there. I think he came late in the Fall of that same year. I think it was before the first of the next year, 1919, but I wouldn't be positive.

My first work I did for Long, for probably four or five months, was just to take care of the sales room and cars—doing little light servicing of any cars that might come in. We had no regular shop at that time. After he moved over to the Eleventh and Main place, I took care of all the servicing on cars. Sometimes, when I was not busy on service work, I helped back in the machine shop. I did very little machine shop work.

I saw some pistons at Long's place, after we moved to Eleventh and Main; they were the slotted type, aluminum pistons. I don't remember seeing any pistons until he moved to Eleventh and Main, where he had his shop. That was right after he moved. He moved them from Quincy. It seems he was making these pistons in Hannibal, and when he left there he brought pistons from the shop in Hannibal to Quincy.

Mr. Richey: I object to testimony about what he seemed to do in Hannibal, as hearsay.

Mr. Bruninga: Q. 88. Do you know anything about what he was doing in Hannibal at that time?

(Narrative continued) He was working on the pistons. I remember when I was there—during the years that I was in Barry, when I would be over there, at one time he showed me an aluminum piston that he was working on. I never went to Hannibal after I started to work for Mr. Long in Quincy, to see what he was doing there. I don't remember of being down there until he started to move. I went down there and helped him move from Hannibal. It was probably four or five months after I

came to work for Mr. Long in February, 1918, that I helped him move from Hannibal to Quincy. That was when he bought this shop at Eleventh and Main, that he moved his shop from Hannibal to this place at Eleventh and Main. We moved some pistons from Hannibal to Quincy at that time.

I saw the pistons, and remember in particular that there was one aluminum slotted type piston. It was not like Exhibit DD; it was slotted different from that. The slots ran from the bottom of the skirt up to the lower ring groove, almost to the lower ring groove. The head of the piston had a slot on each side from the wrist-pin boss, from one wrist-pin boss around to the other. These slots in the skirt ran from the bottom of the skirt up to this slot that went around the head of the piston. I don't remember the number of slots, the number of perpendicular slots. I can make a sketch of what I saw. (Witness makes sketch, which is marked "Defendants' Exhibit EE," with a figure designated as Fig. 1.)

Q. 100. Mr. Bruninga: Under Fig. 2 I wish you would sketch a cross-section of that piston at right angles to the wrist-pin bosses.

(Witness makes sketch as requested.)

(Narrative continued) In Fig. 1, the part 1 represents the slot that runs from the bottom of the skirt up to the slot at the head of the skirt. Part, 2, is the wall of the skirt. Part 3, is the slot in the center of the skirt, and part, 4, is the slot that separates the head from the skirt.

The slots 1, 3 and 4 went through the skirt wall. Part, 5, represents a wrist-pin boss, and part 6, is the part of the wall of the piston in which the wrist-pin bosses is located. The line, 7, in Fig. 1; the wall of the piston on the side where the wrist-pin boss was cut away and that line, 7, is the lower part of that relief. That was cut away to keep the piston from sticking when the head came on it.

Lines, 8, represent ring grooves. Part 9, in Fig. 2 represents the web inside of the piston, to support the parts of the skirt that were cut away. Part 10, represents a wrist-pin boss. Part 11, is the lower part of the ring groove section, and parts 12, represents the slots on either side of the wrist-pin boss.

There were two webs, 9, on each side of the piston, extending across the wrist-pin boss—to the skirt, in

either side; right across the wrist-pin boss, and extended to the skirt on either side, and there was two of these webs, one on each side of the piston. They were cast altogether. When the piston was cast this web was part of the original casting. It was cast on to the skirt and on to the wrist-pin boss.

I saw such a piston like Exhibit EE, when I moved from Long's place in Hannibal to Long's place in Quincy—an aluminum piston. The first piston I saw I don't think had been used; it didn't have that appearance.

Mr. Bruninga: I offer in evidence "Defendants' Exhibit EE."

(Narrative continued) When I saw the piston like Exhibit DD, which I said was in 1913, Ed Cotter was there at the time. He was also there when I saw Exhibit EE. He was a machinist.

I don't remember how many pistons like EE were moved from Hannibal to Quincy, but there was more than one. Long's place in Hannibal was near Tenth and Broadway. After Long moved to Eleventh and Main in Quincy, he started to make pistons. I remember he made some of this type here, which I have just made a sketch of; Exhibit EE. Then, later, he made some that were a little different in regard to slots. One, in particular, that I remember, the head was cut away entirely from the skirt and there was a web run from the head of the piston inside down across the wrist-pin bosses, and extended to the skirt on either side, to support the part that was cut away.

(Witness is asked to make a cross-section at right angles to Fig. 2 of Exhibit EE, on the sheet handed him, which will be marked for identification, "Defendants' Exhibit FF." Fig. 3. After making sketch.) It was something like that. It might not look exactly like it.

In Fig. 3, parts 13, represent slots on either side of the wrist-pin boss. Part 1 is the slot at the top of the skirt that separates the head of the piston from the skirt—that went all the way around the piston. Slots, 13 and 14, went all the way through the skirt. Parts, 15, represent the ring groove. Part 16, is a wrist-pin boss, and 17 is the web that extends from the head of the skirt inside down over the wrist-pin boss and to the walls of the skirt on either side. There was one web, 17, on either side. I don't remember whether there were more or not. Two webs in all.

Fig. 3 is the same general view as Fig. 2. It looks at the piston the same way. I can, under Fig. 4, show a view of that piston looking to the left, towards Fig. 3; a view of the outside of the piston. (Witness makes sketch.)

That view, Fig. 4, is really looking in the same direction as Fig. 3, down on it. Line 16 represents a wrist-pin boss and line 17 is the lower part of the relief around the wrist-pin boss. Lines 18 represent slots on either side of the wrist-pin boss, and 20 is the slot at the head of the skirt, that separates the head of the piston from the skirt.

The piston shown in Figs. 3 and 4, Exhibit FF, was being made at Long's place after he moved his stuff from Hannibal to Quincy. That piston had six vertical slots. Only two are shown in Fig. 4; there were two on the other side and then one on each side, in the center of the skirt. That would come about where the edge of the skirt shows at the line 21, and there was one on the other side in the same position, at the line 22. That piston was being made some time during the early Fall—I don't remember the month—of 1918.

As well as I remember, it was before Charles Chadwick came. That was an aluminum piston. Some of those went into service on the Franklin cars. I put some of the type piston shown in Exhibit FF, in Franklin cars. I don't remember whether that was before or after Charles Chadwick came.

The first pistons I saw of those, were sand cast. I had a set of them in my shop; I junked them a few months ago, of that particular type of piston, that were sand cast. I sold them to a junk man. They were taken out of a Franklin car, series 9, with six pistons. The pistons were in good condition. They showed that they had been used. They were not broken in any way. I don't remember what car they came out of, now. I probably junked it. I junked a number of those old model Franklins in the last few years. I couldn't say how they got in that car.

This Defendants' Exhibit F is the same type of piston that we used there in Quincy. I think this is sand cast. I wouldn't be positive; I don't know enough about those castings to say.

(Mr. Bruninga offers in evidence "Defendants' Exhibit FF.")

The purpose of the depressed part opposite the wrist-pin bearings, in Exhibit F, is to allow more room for expansion when the heat comes on the piston, so the piston won't bind against the cylinder walls.

Exhibit F is the same type as the piston I saw in Hannibal before Mr. Long moved to Quincy, but I wouldn't be sure whether it is the identical type or not. Its construction is very much like it. Comparing Exhibit F with the piston that Long was making in Quincy, after he moved from Hannibal, as well as I remember, it is the same type of piston as he made there in Quincy. As far as the outside construction is concerned, I think Long made identically that type, in Quincy; but I wouldn't be positive about the webs inside. Those webs extending from the head down to the wrist-pin boss there, that I don't remember about. It has been a long time since I have seen any of that type piston.

The cross-webs in Exhibit F are the same as those Mr. Long used, I know. Those are the same as he used there in different types of pistons. The number of slots are the same; the relief on the wrist-pin boss is the same; also the slot extending all the way around.

Defendants' Exhibit R is the same type of piston as Exhibit F. Exhibit F is for a Franklin car. Exhibit R looks like an Oldsmobile size. I wouldn't be positive.

Long made pistons for a lot of different cars—Packard, Oldsmobile, Ford, Franklin, Studebaker—while he was still in Quincy. He made a number of different pistons for different cars. Before he moved away from Quincy. And they were of the type of Exhibits F and R, as far as the slots and webs were concerned. Some of them were shipped out, before Long left Quincy. I don't remember the names of any particular ones we shipped to, before Long left Quincy. We shipped pistons to the Franklin dealer at Peoria, Illinois; we shipped pistons to South Bend, Indiana; to St. Louis, Missouri, and some place in Michigan, but I don't remember the name now; those were aluminum pistons.

They were made in Mr. Long's shop there in Quincy, that is, they were machined there. The castings, most of them he got from Mr. Levett, I think, some place in New York. I believe he got some castings from Gilbert in St. Louis.

Mr. Richey: I object to the answer as just a speculation.

(Narrative continued) We did conduct some tests on pistons of the character of "Defendants' Exhibits F and R"—no, we didn't run any test on the smaller pistons; just the Franklin size was all we made any tests on—like Exhibit F.

The first test that I made was in 1918. We made tests before and we made tests after Mr. Chadwick came. I don't remember any particular test before Chadwick came.

There were different clearances used in those tests. Sometimes they would put them in with just clearance enough to be able to place them in the cylinder. I remember installing one set of pistons in Mr. Charles Bartlett's car, that had a clearance of one and one-half thousandths for the complete set. I brought that order in myself, after the pistons were installed, and it gave perfect satisfaction.

Mr. Richey: I object to the last statement as a conclusion.

(Narrative continued) I don't remember whether I examined the pistons after the test. There was no signs of sticking or laboring, or anything, while being used. I personally drove the car for ten days or two weeks, I think it was, after the pistons were installed. I did not find any binding. I can tell from experience whether a piston is working satisfactorily, while I am driving a car, and those pistons sure did work to my satisfaction.

That "Defendants' Exhibit V" is a book of inventory of the stock that Mr. Long had the time he sold out to Mr. Weems, and it is in my handwriting. I helped to take the inventory.

The notation "Inventory of E. C. Long, October 27, 1919 Machinery and Stock" is in my handwriting. Pages 28 and 29 are in my handwriting. I don't remember now if I took the inventory of the pistons noted on pages 28 and 29, but it is my handwriting. I don't remember the particular pistons noted on pages 28 and 29, or what construction they were. I wouldn't say whether or not any pistons like Exhibits F and R were in stock at that time. Those were the type that we were making, principally, all during the time that he was there, but I don't remember whether that is the type piston we inventoried or not. Long was making that type piston before that inventory was made.

(Defense Counsel offers in evidence "Defendants' Exhibit V.")

It was right after that inventory was taken, that Mr. Weems took over the business. I don't know exactly. I think the deal had been made before the inventory was made. It couldn't have been over a month, I don't think. I continued to work for Mr. Weems, and he continued to make the same type of piston—like Exhibits F and B.

I recognize "Defendants' Exhibit E" as one of the latest types that Mr. Long made. It is the type that the Franklin Automobile Company adopted. Weems made some of those pistons while I was with him—he made a lot of them, while I was with him. After he took over the business he started production just as soon as he could get organized and get his help together; within three weeks after he took over the business.

I don't remember what the production was, but I know they were being shipped out and were being put into cars, within a few weeks after Weems took over the business.

I don't remember whether Weems advertised those pistons, as far as local advertising is concerned. He sent out circulars to Franklin dealers over the country. I don't know how soon that was after he took over the business, but it was the same year that he bought Mr. Long out, and he shipped to Franklin dealers during that same year.

I didn't use many pistons like Exhibit F, after I came to Jacksonville. I never have used anything else only the Long type piston until this year, principally the Exhibit E. I bought some of them from Mr. Long, in Detroit, and bought the balance from Mr. Chadwick and Mr. Weems at Quincy. I found them satisfactory, but quit using them because Mr. Chadwick was not able to furnish them any more, neither was Mr. Long, and rather than send to the Franklin factory and wait for the shipment, I used some other type of piston. I used a Bohnalite, the type that is now being used in the Franklin automobile. I specified the Franklin car when I ordered the pistons, and that is what they sent me. That is a strut type piston. I haven't experienced any trouble with them, so far, but I don't believe I like them as well as the Long. I don't believe I can fit them as close as I can the Long piston. There is more tendency to slap, than the Long piston. The only place I know of now where you can get the Long piston, is from the Franklin factory, and I don't know whether I can get them there. The first split skirt aluminum piston that I ever saw was the piston in Mr. Long's office in Hannibal, similar

to Exhibit F. I don't remember of seeing any other split pistons up to the time I came to Jacksonville, in 1923.

I never knew Edward J. Gulick, and he never offered to sell me a split piston. I heard of him in Mr. Long's, in 1926, when I was in Detroit. I never heard of him any other way that I remember now.

No one, except Chadwick, Weems, Long or the Franklin Company, offered me any split pistons, during the first year that I was in Jacksonville, 1923. Neither the Aluminum Company of America, nor the Cleveland Trust Company, ever offered me any. The only place I got them was from Long and Weems and Chadwick.

Weems was making these pistons like Exhibits F, E and B, during the first part of the year 1920. He made a good many of those Exhibit E, and they were being shipped out.

Miss Anna Landon was the head bookkeeper at Weems, when I was there.

I had not seen these particular pistons E, F and B, these particular ones, before this session—not that I know of. You did not show them to me, no.

Mr. Bruninga: Direct Examination closed.

Cross Examination by Mr. Richey.

I didn't, myself, ship out any of these pistons from the Weems Company. I didn't have anything to do with the shipping. All I know about it is that somebody else told me that they were shipped out. I wouldn't attempt to say how many I saw shipped out. They had—I don't know how many it was. There was times there when I helped inspect the pistons and I know they had big stacks of them. How many pistons, I wouldn't attempt to say. By "big stacks" and "a good many," I mean probably a hundred pistons or more, at a time.

I didn't make any of these pistons myself, while I was with Weems. I don't know how many I saw made. I know they were shipping out a lot of pistons. I saw the boxes nailed up and go out. My service room was right beside the packing room. In some cases I saw them putting the pistons in the boxes.

I know that since around 1920, split skirt pistons have been standard equipment in a few automobiles. I don't know how many different cars. I know they are in the Franklin. I don't know what other cars they are standard equipment in, because my service work from 1918, up until the last year or two, was just on Franklin,

alone. I wouldn't be in a position to know who else made and sold aluminum pistons, then the people I have testified about, nor what cars used them.

I did see different types of aluminum pistons after that, until the last four or five years—like these pistons on the desk here. All the pistons that I remember seeing prior to the last four or five years had possibly one slot in the skirt. I don't remember what car that piston was in, nor do I remember when I saw it. I saw it at an automobile show in St. Louis, probably four or five years ago; I saw some pistons that were slotted with slots on only one side. I don't remember about the slots under the ring lands. My memory is not good enough to tell whether there were any more than the one slot in it, what car it was in, and when it was that I saw it. I know it was four or five years ago.

I don't know whether the Bohnalite piston, like I bought recently for the Franklin car, has become standard equipment. I have seen Franklin cars lately, but I have had no occasion to examine into the pistons. I ordered those Bohnalite pistons through the local wholesale house from Central Automobile Equipment Company. I ordered pistons for a Franklin, Series 11. The order did not go to the Franklin Company; it went to the Company making this Bohnalite piston.

I said circulars were sent out from Quincy, but I didn't send out any. My work was in the shop, and they were sent out in the office. I know the circulars were there; I saw them. I saw the lists of names that they had, and saw them addressing envelopes. I am not positive as to who they sent them, or how many they sent out, but I know this, that they did send out some. I saw them folding them up and putting them in envelopes.

I was at Mr. Long's place in Detroit the first time I heard about Mr. Gulick. That was during the time I testified in these interference cases. Perhaps I talked to Mr. Long and Mr. Fletcher, the attorney, about the pistons I have testified to here; I don't remember now. I don't remember of any one else. That was in 1926, and I don't remember of going over any pistons until I came to testify. I don't remember whether I talked to Mr. Long or Mr. Fletcher about those pistons before I testified. That was six years ago.

Mr. Richey: It is agreed that Mr. Sidney D. Royalty testified in the Hartog-Long-Gulick Interferences Nos. 49569, 49570, 49571 in 1926.

(Narrative continued) I don't remember now what I testified at that time. I don't remember testifying that since my first employment with Mr. Long I had seen three or four different kinds of slotted pistons of Mr. Long's. I did testify that since my first employment with Mr. Long I had seen three or four different kinds of slotted pistons of his. I also testified that during 1918 and 1919 three or four different types were brought to my attention. That is to say, during the years 1918 and 1919 and including the form shown in Exhibit 1, there were altogether perhaps four or five different kinds of piston shown me by Mr. Long. I so testified in that case. I also testified that I made a number of tests on different sets of pistons, in that case. I also testified that I was not able to give any definite dates as to "when we tried any certain piston."

Mr. Richey: And when asked what were some of the changes made in these pistons, from test to test, you answered that that would be pretty hard to tell. That is correct, is it not? The entire question and answer were as follows:

"XQ. 61. What were some of the changes made in these pistons from test to test? A. That would be pretty hard to tell, just the different changes—I remember a few of them. In regard to the oil holes drilled in the wrist-pin boss, at first he used a very small drill to drill these holes, afterwards he used a larger drill. On Exhibit 1 at first we tested the piston without having any holes drilled below the ring groove on the wrist-pin boss sides, later we tried the same pistons with small holes drilled through the skirt. We also tried these pistons with skirts with different thicknesses. The ribs and also the webbing on the inside of the piston were changes slightly from time to time—that's about as well as I remember."

(Narrative continued) That is correct, and is my present recollection. I also testified that the other changes I did not remember, and that I didn't remember the order of these various tests; that I might test one type one week and then in a week or two come back with the same type with possibly a change or two made in it. That is my present recollection of it.

In this sketch I made, Exhibit DD, these webs ran straight across the piston, as well as I remember. In Fig. 2, the ends of the struts engage the inside of the

skirt on either side of the ring—wrist-pin boss, they extended right across the boss to the skirt, on either side. As to the part of the skirt they engaged, in Fig. 2, this diagram is not regular here. This is supposed to come across and engage this part here (indicating on diagram); between the vertical slots. Then they went straight over and engaged the other side of the skirt. This slot a, as near as I remember, was about in the center of the piston. This web here came in something like here (indicating on sketch).

Mr. Bruninga: Let him mark it in dotted lines, Mr. Richey.

(Witness marks on sketch. Narrative continued.)

In each case, the ends of the webs were near the vertical slots. I don't know just how to go about making a bottom view of the piston, looking down on it, on Exhibit DD.

XQ. 66. Just like you were looking into it, like that; looking right into the bottom of it; like you were looking down in a bucket. A. It is one thing to look down in a bucket, and another thing to make a diagram of it.

XQ. 67. In other words, you are having difficulty in making the diagram? A. Yes, sir.

XQ. 68. Although that is simpler than the other three diagrams you have made. You don't remember how it looked, looking down into the bottom of it? A. Yes, I know how it looked.

XQ. 69. Can you or can you not make it?

Mr. Bruninga: The witness can take his time, if it takes an hour to do it.

Mr. Richey: I have no objection to his taking time, but he is not making any progress; just sitting and looking at the paper.

(Witness makes sketch, which Mr. Richey marks Fig. 4.)

XQ. 70. You don't show the webs in the same way you did in Fig. 3, do you? A. I aimed to.

XQ. 71. That is not looking right down on the piston, into the bottom of it, is it, like I asked for? Can you make a view of the piston looking right into the bottom of it?

(Witness makes sketch.)

XQ. 72. Where was the slot, A? Put a lead line there and mark it "a." A. There is the slot, "a" (indicating on sketch).

XQ. 73. Would it be right there, you say? A. Yes, sir.

XQ. 74. Now, where would the slot, i, be? A. Over on this side.

XQ. 75. Where would the slots, g, be? A. That is wrong.

XQ. 76. You have them wrong; you want to put them here (indicating)? A. Yes.

XQ. 77. They would be outside, wouldn't they? A. Yes, sir.

XQ. 78. First you put them on the inside of the struts and then you put them on the outside; that is correct, isn't it? A. Yes; I didn't notice where the struts came there until I—I am not used to making diagrams.

XQ. 79. Now you have your slots a good deal wider apart in the last figure which you made, which I will mark "Fig. 5," than you have in Fig. 2, have you not? That is correct, isn't it? A. Yes; the diagrams are not proportioned right. This boss should extend in here further.

XQ. 80. In Fig. 5, that should extend in further? A. Yes, sir.

XQ. 81. And that would bring the struts in closer together? A. Yes, sir.

(Narrative continued) That would bring the slots, g, in closer, and the ends of the struts on the slot, a, side of the piston, shown in Fig. 1, would be close to slot, a; they would be closer than shown in the last diagram. They would have to be close enough together to clear the slots, g—to be inside of the slots, g. If they were in that close, over close to the slot, a, they wouldn't be close enough to prevent those wings from flexing back and forth. I don't remember now how close they were, after nineteen years. I just know they were there and that is all. I am not used to making diagrams. The sketch DD shows my recollection of what I saw nineteen years ago. This view (indicating) comes nearest showing what I saw; Figs. 1 and 2; as far as the inside is concerned, I don't remember a lot about it, but I know the general principle of the inside.

XQ. 90. You don't remember the inside, but you are just deducing that from what you remember about the

outside? A. I know just about what the construction was inside, but I am not as familiar—

XQ. 91. You say you know it, but I am asking what you remember. A. Yes, sir.

XQ. 92. Is it not a fact that you don't remember what the inside was, and you are deducing what that should have been from what you do remember about the outside?

Mr. Bruninga: Does the witness know what the word "deducing" means?

The Witness: I think so.

(Last previous question read to the witness.)

A. It is a fact that the inside is not as familiar to my memory as the outside.

Mr. Richey:

XQ. 93. It is pretty hard to remember these details for over nineteen years, isn't it? A. Yes, it is.

XQ. 94. You testified in those interferences, in 1926, as follows:

"Q. What do you mean by the sides of the skirt? A. The web extended right across the wrist-pin bosses on either side, and straight across, as I remember, extended over to the side of the skirt of the piston. I haven't seen one of those pistons since Mr. Long left Quincy. It's pretty hard for any one to remember the exact detail of the construction."

You so testified, did you not? A. Yes, sir.

XQ. 95. At that time, in 1926, you were testifying about a piston that you said you saw in 1918; that is correct, isn't it? A. Yes, sir.

XQ. 96. And when you gave that testimony you had reference to eight years and now you are talking about nineteen years; that is correct, isn't it? A. Yes, sir.

(Narrative continued) I don't remember only one or two pistons that I saw back there in 1913, like Exhibit DD. Mr. Long was working on a motor and that is the cast iron piston with the T-slot and U-slot in it, were the type he was using in that motor. I didn't see them in use in a motor and I don't know whether he used them in a motor or not, of my own knowledge.

I don't remember whether I saw one or two of them; I remember one distinctly. I don't remember whether that was the only one I saw; I would not be positive that

I didn't see more than one. I don't know whether he patented this one I said I saw in 1913, or not. I don't know whether he patented any of them; I was not interested in that part of it. I also took his word for it that he designed them.

Mr. Long was in Detroit, Michigan, the last I knew of him. That was probably three or four months ago.

I junked a bunch of old Franklin pistons a few months ago; took them out of a car and junked them; but I don't remember whose car it was, nor where I got it. I just found those pistons in my shop; I don't know how long they had been there. They weren't in a car when I found them; they had been taken out of a car which I had junked—a number of these old type Franklins, in the last four or five years. I would not attempt to say where they came from. They had been there since I had started to work in the shop. What I meant to say was, that they had been taken out of a car after I started to work in the shop. I took them out of the car, myself, but I don't remember whose car it was, or where it came from. As I said before, I junked a number of these old Franklins. I don't remember what particular car these came out of, but the pistons that I had taken out, which is quite a number in the last nine years, had been thrown aside there, and when I began to gather them up I found one set of these old pistons.

In giving my employment I did forget to mention that at one time I worked for the Wells Fargo Express Company at Kansas City; I was there a few weeks.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

I am not a draftsman, and never took a course in drafting.

Mr. Bruninga: Deposition closed.

Mr. Bruninga: Now, I have a deposition of Mr. Stelman here, taken in St. Louis. It is a fact deposition, going to this same matter. Mr. Stelman is here, but as I understand Mr. Richey is perfectly agreeable to let me read that deposition of Mr. Stelman because he is going to be examined as an expert on the patent situation generally, after the deposition. I have no objection if the other side wants to cross examine on this fact testimony.

The Master: You mean use the direct, not the cross?

Mr. Bruninga: We will read his entire deposition to the Court. If necessary Mr. Stellman could come in and read it himself, in order to save time.

Mr. Watts: As I understand it from Mr. Richey, we haven't any objection to raise on the ground the witness is here, therefore his deposition should not be used, so we are perfectly willing to go ahead with the deposition part if we may have the right to further cross examination.

The Master: Very well.

(Thereupon, adjournment was taken to 9:30 A. M. of the following Monday morning.)

(At 9:30 A. M., Monday, January 30, 1933, the hearing was resumed. Present: Messrs. Richey & McCoy for plaintiffs; and Messrs. Bruninga and Sutherland for defendants.)

(Reading of deposition of Mr. Louis M. Stellman continued from page 454 to page 466.)

LOUIS M. STELLMAN, a witness produced in behalf of Defendants, being duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Bruninga.

My name is Louis M. Stellman; age 46; and I reside at Syracuse, New York. I am a consulting engineer, specializing in gasoline motors and automotive products. I studied mechanical engineering at the University of Michigan. I entered the employ of the H. H. Franklin Manufacturing Company, of Syracuse, July 1, 1909, as a student engineer, working in the mechanical laboratory. That company at that time was manufacturing automobiles with air-cooled engines. I severed my connections with the Franklin Company in June, 1924.

I worked through various departments of the Franklin Company between July 1, 1909 and June, 1924, in an engineering capacity. I finally became Chief Engineer in May, 1920, I think it was, and was Chief Engineer when I left there. I was Assistant Chief Engineer before that.

The Franklin Company was manufacturing and marketing the model designated as Series 9-A during the years 1915 and 1916. As I remember, we started that

model with a cast iron piston in the year 1915, and then changed to an aluminum piston in 1916. The first aluminum piston was a trunk type piston, with a slotted lower end, although, I think, the first aluminum pistons we used were a plain trunk type piston. Afterwards we slotted the lower ends. That slotted piston, essentially, was a trunk type piston with slots running vertically in the piston skirt up to about the center line of the wrist-pin boss. Those slots were four in number, I think, and ran from the bottom toward the top of the piston, and were located on each side of the skirt. By "side of the skirt" I mean the side opposite the plane through the wrist pin boss. The piston marked "Defendants' Exhibit B" is the type of piston I have been trying to describe. It is the aluminum piston which Franklin used after this four side slot experience. I should judge that Exhibit B is a Franklin piston. (After measuring Exhibit B.) It is the same bore, the same diameter, as the Franklin piston, and is a Franklin piston of that period. Franklin started to use that type of piston in 1916, in production, and used it until October 27, 1920, I think. It was put out as part of the new car, in regular standard Franklin production. Prior to that time that particular type piston was not used for anything else.

The slots of that Exhibit B piston allowed the piston to be used with less trouble from piston slap and noises in the engine; piston noises in the engine.

Franklin used a piston of that particular construction, with four slots in it, later than 1916, and it was always used in production in just that form. In service we later incorporated a split ring in the bottom of this piston to expand the piston—help to expand the piston against the cylinder walls. At the Franklin factory the Service department that supplied the dealers with parts, was a separate organization from the organization that built new cars. The Service department supplied this split ring in pistons, and separate from the pistons, for dealers to install in pistons they already had. This ring fitted into a groove which was turned inside of the bottom of the skirt, this groove holding the ring in the piston. This ring was a split ring, a good deal like a piston ring except it was made of steel, and was put in under different pressure.

There was a Franklin car, known as a Series 9-A, put on the market along in 1915. It was shown in New York in January, 1916, and in the Chicago show of that

same year, I think, the last of January, 1916. I attended that Chicago show.

I first met Elmer C. Long when he came to the Franklin factory in March, 1916, after the Chicago show. I heard of Mr. Long through one of our dealers who came to the factory after the show, Mr. Frank Sanders. At that meeting with Mr. Long in 1916 he showed me a piston of his design. It was essentially a trunk piston that differed from an ordinary trunk piston in that it had the skirt supported by two webs, which were in turn supported by the wrist-pin boss, and the piston skirt was divided, or separated, from the head of the piston by a circumferential groove, and it was also divided into pads by six slots running vertically from the bottom of the piston to the circumferential groove. This divided the piston skirt into four of these pads, each one of the pads being supported by this web, or by a web, which ran from the boss to the interior of the pad. Those pads were located on the sides of the piston parallel to the plane running through the center of the wrist pin boss. That top groove was located just below the lowest ring land, and it went all the way around the skirt. The Franklin Company adopted a piston of the type I have just described, in standard production on October 27, 1920. It was adopted in service in April, 1920. By that I mean that the Service department offered it to its dealers as a replacement proposition for pistons already in service at that time. Those pistons that the Service department furnished to dealers were sand cast aluminum alloy pistons. The first outstanding test of that piston by the Franklin Company before the adoption of it by the Service department, that I remember, was one that we made with Mr. Long, I made with Mr. Long, in which we put the pistons in a car, in an engine, and drove the car to New York, from New York up into New England, and back to Syracuse. That test was made in March, 1919. About that time, or a little after, the Franklin Company entered into an arrangement with Mr. Long.

Defendants' Exhibit F is what we call a Long type piston, suitable for use in a Franklin motor, and is a sand cast piston, I should say. That piston is similar in construction to the one that Mr. Long showed me in March, 1916. It might have been some different in the internal ribbing, but essentially that is the design. The internal ribbing that I have in mind would not affect the operation of the piston.

The photostat marked "Defendants' Exhibit Y" represents an ordinary trunk piston, I should think.

(Witness makes certain markings on Exhibit Y.)

"a" in Figs. 5 and 6 represents the top of the web. The groove is the same line running circumferentially around the piston, shown by this same line "a." It also designates the top of the groove. That groove ran all the way around the Long piston which he showed me in 1916, so that the skirt was separate from the head. The skirt was supported on the head by the webs "b" which were fastened to the wrist pin boss. The parts designated "c" are vertical slots in the skirt of the piston which went from the bottom to the circumferential groove just below the ring lands.

3 and 4 represent just the ordinary trunk piston. "d" represents a rib between the head and the wrist-pin boss. Fig. 1 is taking a side view of the piston and Fig. 5 is taking a section through the center line of the wrist-pin, to vertical section. The slots "c" and the webs "b" in these figures are reversed, which is a mistake in drawing of the No. 1 view. In Fig. 1 the slots should be shown as outside of the web. Fig. 5 is correct. Figs. 5 and 6 essentially represent the piston that was shown to me by Mr. Long in 1916. I carefully examined that piston at that time, because I was interested in a piston design, or any improved design for the Franklin car.

The construction, Exhibit B, was in use in March, 1916, but not in an entirely satisfactory use. I considered Exhibit B better than the ordinary unslotted trunk piston. As I remember it, that piston was supposed to run three thousandths at the bottom and nine at the top, that is, the top of the skirt. The clearances above the skirt are greater than that, between the ring land—the clearance between the ring lands was greater than nine thousandths. I do not know what became of the piston that Mr. Long showed me in March 1916.

Mr. William M. Venner was in the employ of the Franklin Company in 1916. He had been previously employed by the Franklin Company, I should say, for a number of years.

The Long pistons that were used in the test in March, 1919 were similar to Exhibit F. There were six pistons used in that test. On that particular test, I think we put them in at two thousandths clearance between the cylinder and piston on diameter, they being straight pistons—

two thousandths clearance all the way up the skirt through the circumferential groove. Those pistons were aluminum alloy, and were furnished direct to me by Mr. Long. The distance covered in that test was about nine hundred miles. In New England we encountered spring weather, but some snow and considerable mud. In New England we didn't have much concrete road. We went up there purposely to try the car out through heavy going and hard mud roads. I remember that on the way back we came up over the Mohawk Trail, which is rather a tough mountain grade, and we had, as I remember, several inches of snow on the ground. I personally made a report of that test, to the management of the company, which was an inter-departmental report. The two sheets of paper dated March 18, 1919, which you have just handed me, entitled, "Test on Long pistons" is the report of the test to which I have just referred. It has Mr. Murphy's initials, who was then Chief-Engineer of the Company, up in the upper right-hand corner of the first page. The initials in the upper right-hand corner are in Mr. Murphy's handwriting. I dictated the report, soon after the trip, probably within a day or two after the trip. I have not recently entirely read that report.

(Witness reads report.)

That report refreshes my recollection as to what time the test was made.

Aluminum pistons, furnished by Mr. Long, similar to those shown in Exhibit F, were used in that test. I don't remember as that report describes the pistons in definite detail, but my recollection is that the internal ribbing was somewhat different from those in Exhibit F; that is, not so that it affected the performance of the piston in the motor. I think the slotting was the same; the webs that support the pads were the same; it had the same number of pads, and it had the same circumferential groove.

I examined those pistons after the test run, and I considered them very good. They showed no practical—they were in every way satisfactory.

I can positively identify this report of March 18, 1919, which is marked "Defendant Exhibit Z," as one made by me at that time.

Mr. Bruninga: I offer this report in evidence as "Defendants' Exhibit Z." I want to substitute a photostat.

Mr. Richey: I have no objection to your substituting a photostatic copy of it for the original, on the same condition, that we may be permitted to see the original, and make any corrections that may occur.

(Narrative continued) The Franklin Company entered into a contract with Mr. Long after that test run, so that he was protected in connection with certain considerations, if and when the Franklin Company used a piston of that kind.

Mr. John Wilkinson was Vice-President of the H. H. Franklin Manufacturing Company, and I know his signature. The signature appearing on the Memorandum of Agreement dated March 20, 1919, between Elmer C. Long of Quincy, Illinois, and H. H. Franklin Manufacturing Company, and marked "Defendants' Exhibit AA," is Mr. Wilkinson's signature. I have not seen that particular agreement, but I have seen copies of it.

(After examining document) That is the agreement which I understood had been entered into between the Franklin Company and Mr. Long.

Mr. Bruninga: I offer in evidence "Defendants' Exhibit AA," and I should like to have counsel stipulate that I may substitute a photostat.

Mr. Richey: We agree that a photostat may be substituted for the original, subject to correction, if there are any errors, and with the understanding that we may see the original at any time we wish.

(Narrative continued) "Defendants' Exhibit 2" states "Several tests have been run in connection with this piston; the first being a set-up test on the block with baffle plates under the cylinders which did not give a sufficient amount of oil so but what a set-up was obtained in about nine minutes." I remember that particular test. The piston used in that test was very similar in construction to the one used in the test described. It was practically the same in construction as Exhibit F. That test was a difficult one; more difficult than would be employed in production—in a regular production piston at that time.

I can't remember definitely other tests of Exhibit Z. All I know, we were experimenting with the piston considerably between the time Mr. Long first showed it to us and the time of the test reported in Exhibit Z.

I remember Mr. Gillett, of Chicago. He was a banker, a personal friend of Mr. Franklin. We built a Franklin car for Mr. Gillett's use in which we incorporated a set of pistons similar in design to those used in the test, the test called Exhibit Z. These pistons were installed in a motor in this car, and the car was shipped to Mr. Gillett for his personal use. I don't know that he knew that it had special pistons in it, but we considered these pistons were better than the pistons in regular production run of cars, and, therefore, we put a set in Mr. Gillett's car, because we liked to give him the best of anything that the Franklin Company had. This happened about two months after the report, Exhibit Z, was made.

The blue-print marked P-3984 of H. H. Franklin Manufacturing Company, marked for identification "Defendants' Exhibit BB" was obtained by me personally from the files of the Franklin Company just last Monday. That print represents an aluminum piston designed after—or, the principles incorporated in the piston shown in Exhibit F. I have no personal recollection of the making of that drawing. I cannot tell who made it, by looking at this print, but I could from the original. I have no personal recollection of when this drawing was made. Within a few weeks, possibly a month after the test, there were some pistons made like those illustrated in that drawing, and those pistons were sand cast and were given a test. The pistons operated satisfactorily in that test.

I understand that Mr. Long received royalties from Franklin, in accordance with the agreement Exhibit AA. However, I never saw the checks.

I recognize "Defendants' Exhibit C" as a copy of a Service Department bulletin as furnished by the H. H. Franklin Company. I personally received such bulletins in 1920. Those bulletins were dated on the day they were written, usually; then they were printed and sent out within the next day or two. This last item on that bulletin states that on and "After April 15 the Service Department will be able to furnish Long Type Pistons in the standard size. These are straight pistons with two to three thousandths clearance. Their weight is approximately the same as the standard piston. While these pistons have not proved satisfactory in production, we find that they work out very well when used in slightly worn cylinders; cylinders that are not worn more than

.005 to .006 inch. If the cylinders are worn more than this they should be rebored. Long Type Pistons will be sold at the same price as the standard piston; viz, \$8.50 list, complete with wrist pins, and rings, subject to the regular discount. Oversize, Long Type Pistons cannot be furnished."

Those Long Type Pistons were furnished by the Service Department on April 15, 1920, or soon after. No bulletins like that issued before the Franklin Company was ready to furnish pistons; that demonstrates to me that they had the pistons practically ready to ship to their dealers. I should say that the Franklin Company was ready to deliver pistons similar to type F, shown.

Q. 191. This bulletin, Exhibit C, bears the statement which you have previously quoted: "While these pistons have not proved satisfactory in production, we find that they work out very well when used in slightly worn cylinders"; have you anything to say about that?

Mr. Richey: I object to the question as too broad; it invites opinion, speculation, and hearsay.

Mr. Bruninga: I will ask this other question:

Q. 192. Can you say why those pistons had not proved satisfactory in production?

The Witness: We had trouble in getting the Long piston in production, because of the green condition of cylinders, as the pistons were started through the manufacturing test. These cylinders had a certain amount of roughness, inasmuch as it was a ground surface in the bore of the cylinder, and the grinding wheel would leave a fuzz, or, to a certain extent, rough surfaces on the cast iron. Those rough surfaces had a tendency to cause the piston to score in the cylinder, when it was first started up, and run in a production test. After April 15, 1920 they worked out in service very satisfactorily. The first pistons furnished by the Service Department were sand cast. Just before they put them in production, a satisfactory die casting was received. There was trouble in getting satisfactory die castings. It was difficult to make that type of piston in a die casting, and we had some trouble in getting dimensions just as we wanted them in a piston casting.

Cars were actually shipped by October 27, 1920, with Long pistons incorporated in them. By "Long pistons" I mean pistons designed "similar" to those shown in Exhibit F, but of the die cast type.

I recognize Exhibits E and G as die cast pistons that were used in the Franklin car.

I recognize "Defendants' Exhibit D" as a Service Department bulletin issued by the Franklin Automobile Company, similar ones of which were received by me at that time. This bulletin is dated November 11, 1920, and it specifically says that, "All Series 9 cars have been equipped with pistons made from this material and are giving satisfactory service."

I had nothing to do with the preparation of the bulletins, like Exhibits C and D, except that I may have furnished information in connection with them.

Die cast, Long type pistons, such as Exhibit E, were in production in Franklin cars on November 11, 1920. No sand cast pistons were used in what we considered regular production of Franklin cars, that is, in the Long type.

After doing experimental work on the particular design being tested, the Franklin Company oftentimes put through a certain number of specific designs through the regular production channels, to try them out as to their suitability for production work. Usually, this was done with some few cars before the product was put into regular standard production.

I think that twenty cars were put through with pistons similar to Exhibit E, before Exhibit D was issued; during the summer before that date.

Defendants' Exhibit H is another Service Department bulletin, dated April 18, 1922. It was issued probably within a day or two of the date that appears thereon.

Defendants' Exhibit I is another Service Department bulletin, issued under date of February 20, 1923, and was probably issued within a day or two of that date.

The Long type pistons, similar to Exhibit C, were being used in Franklin cars when I left in June, 1924. They were used in, I should say, twenty-five to thirty-five thousand cars, up to that time, six pistons for each car.

The oval piston referred to in Defendants' Exhibit H was a trunk type piston, ground so that the section through the skirt would be of slightly oval shape, the large diameter being perpendicular with the wrist-pin. They were used in regular production for a time—as my memory goes, about in 1922—for a few months, but were

discontinued because of the fact that they did not give entire satisfaction. I don't think any royalty had to be paid on those oval pistons.

I never met Edward J. Gulick, of Elkhart, Indiana. I never saw one of his pistons in production. None of his pistons, that I know of, were offered to the Franklin Automobile Company, while I was there.

I don't think any split pistons were offered to us by the Aluminum Company of America, while I was with Franklin, prior to November, 1920. I don't think they were particularly interested in split pistons, prior to 1920.

Mr. Richey: I object to the last sentence as being a conclusion of the witness, and incompetent.

No split pistons, to my knowledge, were offered to the Franklin Company or to me as chief engineer, prior to November, 1920, by the Cleveland Trust Company, of Cleveland, Ohio. I have an idea that split pistons, if that means some portion of the skirt being slotted, were offered to us prior to November, 1920. I can't designate any particular person or company. I don't actually know of any split pistons being offered to us before that date (November 1920). There was a need for such a piston by the Franklin Company prior to November, 1920.

I should say that an air-cooled motor, such as used in the Franklin car, was a difficult motor to equip with suitable aluminum pistons. I did not know of any car which was more difficult to equip with aluminum pistons prior to November, 1920.

A straight aluminum alloy trunk piston without any splits in it would not work in a Franklin car, because you had to give it too much initial clearance. I remember we gave the bottom of the skirt five thousandths and the top nine thousandths, between the cylinder and the piston. The clearance given to Exhibit B pistons was three thousandths at the bottom and nine at the top of the skirt.

We gave the Long pistons four to five thousandths clearance, as I remember, all the way up the skirt, when we put them into production in 1920. I would say, then, that there was a crying demand for an aluminum alloy piston that would work with a minimum of clearance, in the Franklin car, before November, 1920. The Long piston supplied that want of the Franklin Company, the best of any at the time.

I have had occasion to examine other pistons on the market, even to date, and in my opinion the Long piston is still the best piston on the market for operation in automobiles.

I advised that the Long pistons be put in the Gillett car. I would not have put anything in Mr. Gillett's car, as an experimental car, in the sense that we wanted to try out anything that was not already proven satisfactory.

The Franklin Company did not essentially change the construction of the Long type piston from that illustrated by Exhibit G, during the period from April, 1920, to June, 1924. All of those pistons had six vertical slots, with a horizontal groove at the top, below the ring lands, and with webs extending from the wrist-pin bosses and going to the four pads, as in Exhibit G. They were relieved opposite the wrist-pin bosses. Pistons of that general design were furnished by the Service Department before July, 1920, but before November 1920 they were sand cast. They were not exactly like Exhibit G.

Exhibit F is apparently one of the sand cast pistons that was furnished by the Service Department during that time.

Mr. Bruninga: Take the witness.

CROSS EXAMINATION by Mr. Richey.

When I went with the Franklin Company they were using an ordinary iron trunk type piston, and I think we used the iron piston until in 1916. I can't tell you in detail what changes we made in the iron piston during that period, but we changed models several times; I know we changed the size of the piston. I presume we changed the construction of it. The trouble with the iron piston was that it was too heavy, and was too poor a conductor of heat; I would say that was the fundamental difficulty with cast iron.

Mr. Bruninga: This line of examination is objected to as not very material, and as having no foundation in the direct.

Mr. Richey: The witness was asked about iron pistons.

Mr. Bruninga: None of the patents in suit is for an aluminum piston per se, or even a die cast aluminum piston, although the Aluminum Company of America wants to call that a permanent mold piston.

Mr. Richey: The direct examination has not been concluded by the patents in suit, by any means.

(Narrative continued) It was known in 1909 and 1916 that aluminum was lighter and a better conductor of heat than iron, and, I presume, better material for pistons. I thought it was better material for pistons during that period. Another trouble with the iron piston was that, due to its poor conductivity of heat, it would run hotter and collect more carbon. The aluminum piston did not have that fault to as great a degree as the iron piston, probably because it was a better conductor of heat.

XQ. 14. And you know that from 1909 to 1916, did you not?

Mr. Bruninga: In order to avoid repetition, I should like to have it understood that my objection goes to this entire line of cross examination.

Mr. Richey: It is understood that the objection applies, without being repeated.

The Witness: I don't think, in 1909, the question of aluminum pistons had come up to any great extent, but some time during that time.

If we thought of the use of aluminum as a piston in a motor, we probably thought of the advantages of aluminum over iron. The faults of the iron piston, and the fact that the aluminum piston did not possess those faults, was generally known, I should think, in the automobile business in those years.

I think we gave the iron pistons two thousandths clearance, straight. That is the desirable clearance, approximately. The trouble with any greater clearance is that it pumps more oil and more gasoline, and it is noisy due to the slapping.

The Franklin Company were always working with pistons, to make a better iron piston, if they could, to overcome those disadvantages.

In the first part of 1916, I should say, the Franklin Company adopted a trunk type aluminum piston which was more or less a duplicate of the iron piston that they had been using previous to that,—it wasn't a duplicate but it resembled it. The clearance we gave this piston was five thousandths at the bottom of the skirt and nine thousandths at the top of the skirt—it tapered. Those pistons slapped more or less, and they pumped oil. There was not a serious objection to their pumping oil; probably

they did with some; all pistons do, some. The greater the clearance, the more they pump oil. We probably had some trouble with the pistons sticking in the cylinders and scoring, but the major trouble with them was noise, slap. We gave the aluminum pistons greater clearance, because aluminum expands faster under heat than iron, and we had to give that clearance to keep them from expanding up to the iron cylinder, and keep them from sticking or scoring. We used that trunk type aluminum piston until we went to the Long type piston.

We used the trunk type pistons without any splits in them for about a year to a year and a half, then we split them like Exhibit B, to allow equipping them with less clearance at the bottom of the skirt, to try to overcome slapping and noise. We improved the condition, but we still had some trouble with it. We used three thousandths clearance at the bottom of the skirt of that piston and nine at the top. We did not have so much trouble with those pistons sticking or scoring, but we had some; that is, not as much as with the trunk type. We modified that piston by putting an expansion ring in the bottom, but that was done principally in service, I should say, in 1917 or 1918. Then in 1920 we went to what we call the Long type of piston. That Long type piston had a clearance allowance of four to five thousandths all the way up the skirt. That piston did not slap or make a noise to any appreciable extent. I never saw an aluminum piston that didn't make some noise. That Long piston with four or five thousandths clearance did make a noise. Of course, if you ran it with two thousandths it would still further reduce it.

We tried out this oval piston in about 1922. I am not sure why we tried it out, but I think it was to get away from paying Mr. Long that royalty. This Long piston is, relatively speaking, an expensive piston to make. I heard that the Franklin Company did discontinue the Long piston along about 1928, or somewhere along there.

I do not know of any other automobile company that adopted this Long piston as standard equipment.

Other types of aluminum pistons were adopted by other automobile manufacturers.

The companies who supplied the castings to other automobile manufacturers, were The Aluminum Company, Walker Levett, and the Bohn Aluminum and Brass Company. I don't know whether or not the Kant Skore Company of Cincinnati supplied any for production. I

understood they did supply them for replacement. I have seen those pistons that were supplied, after they were machined up. I know in general what they were like.

In general design, the pistons that were furnished by the Aluminum Company, Bohn and Kant Skore, to manufacturers, were like that shown in the drawing of the Maynard patent 1,655,968, in this suit, but I don't know that they were slotted like that. I know that that piston shown in the drawing, and commonly known as a split skirt piston in the industry, was used in quantities since around 1921. That is the piston that was machined from many of the castings that were furnished by the companies I have named, to the automobile manufacturers and replacement people, sometime during that time, and still is, as far as I know.

I do not know of anybody using this Long type piston now.

With reference to Exhibit Z, "Hartog v. Long v. Gulick Int. 49,572" and "Hartog v. Long Int. 49,581, Long Exhibit No. 3," I testified in those interferences about that report, on behalf of Long, in January, 1926, I think it was. At that time, when my attention was called to the fact that some of these views on Exhibit Y did not check with each other, I made a side remark that did not get on the record, "I am afraid I am getting rusty." I said that in apology for getting these drawings in disagreement with each other. I am even more rusty now than I was in 1926, when I testified in the interferences, with respect to my drawings, but not with respect to my recollection about these things. I don't think my memory is any better than it was in 1926, but my recollection is better now.

Our piston troubles in 1916 were greater than they were in 1919.

I came here from Syracuse, New York, just to testify in this case. I hope to be paid on a *per diem* basis, but I have made no arrangements about being paid. I charged fifty dollars per day in the aforementioned interferences, and I expect at least that much for testifying here.

I attended the Automobile Show in Chicago in 1916. I also attended automobile shows of other years, but I don't remember just what years. I did not attend them while I was with the Franklin Company, however.

I have seen Mr. Verner since I came to St. Louis on this trip, but I did not talk to him about this case. I just talked to him a minute and said "Hello," and "How are you?" and passed the time of day.

Mr. Venner came to the Franklin factory more or less frequently while he was at South Bend. I saw him from time to time on those visits.

When Mr. Long showed me this piston in my office at the Franklin plant in Syracuse, in March, 1916 (probably about the middle of the month), there were probably others present besides Mr. Long and myself, but I don't remember definitely who. My office was in the engineering department on the second floor, about a block from the experimental laboratory which was on the ground floor. Mr. Long and I talked several different times about that piston while he was there, always in my office. I don't remember having any conversation about it at the door of the experimental laboratory, or anywhere outside of my office.

There was one rib in the top of that Long piston. I am certain that the slot was cut all the way around the top. If Mr. Chadwick, who went to work for Mr. Long in the latter part of 1918, testified that he and Mr. Long designed that slot all the way around in that piston, I would still say that this 1916 piston had a slot all the way around. The Exhibit Z report is not the only report that we had of a test of these Long pistons, but that is the most complete report as of that date. I know there were other reports at the Franklin Company in Syracuse, but this is the only one I have. Mr. Long furnished the copy of that report when I testified in the interferences in 1926.

The statement in Exhibit C, to the effect that at the date of that bulletin, April 8, 1920, the Long pistons had not proved satisfactory in production, is true. They worked better in slightly worn cylinders because of the fact that the grinding glaze had been removed in the cylinder, due to previous contact with other pistons. I don't think it was because it gave some clearance, but simply that the surface was smooth.

The statement in Exhibit D, "The distinct advantage as a material for pistons which an aluminum alloy, with its very light weight and great ability to throw off heat, has over cast iron, is conceded by all automobile engineers" was a true statement at that date, and I should say that statement would hold true for a great number of years before 1920. The following statement from bulletin, Exhibit D, is also true:

"The Franklin engineers, however, realizing the particularly desirable features of the aluminum alloy

piston, have for the past three years been conducting exhaustive experiments with a view of securing a design that the undesirable features would be eliminated." This statement was made as of November 11, 1920. I also understood the following statement in Exhibit Z to be true: "Mr. Long, our dealer in Quincy, Illinois, was out here with a new design of aluminum piston for our motor in connection with which he has had four claims allowed by the Patent Office." I suppose Mr. Long told me that these four claims had been allowed on this new design of piston. When Mr. Long came to Syracuse in March, 1919, he didn't have any of these pistons with him, that I know of. I don't remember whether he brought any in March, 1919, but we had pistons there that we had been experimenting with, of this design. I think Mr. Long did bring some pistons like Exhibits E, F and G with him when he came to the plant in March, 1919—I can't tell just how many, but I think several sets. I don't remember whether or not he sent back home to have some more sent down at that time.

It was our custom to make reports of our tests, like Exhibit Z, within a day or two after the tests. The set-up test on a block with baffle plates under the cylinders, referred to in the report, was made, I should say, a few days previous to the report.

One of the troubles we had on production cars, which is referred to in Exhibit Z, was due to pre-ignition. Pre-ignition is caused by some action in the cylinder that causes the charge to combust before the time that the spark would ordinarily ignite the charge. The trouble referred to there, I think, was in connection with some of the threads in the bottom spark-plug hole, below the point where the spark-plug came in this hole, becoming incandescent and causing it to ignite. I understand that that was sometimes caused by the top of the iron piston getting too hot. Aluminum pistons helped this condition.

Some time during the contract, I think, the royalties that Franklin paid Long on these pistons was ten cents a piston.

When Mr. Long showed me these pistons in March, 1919, he was there sometimes all over the plant, but principally in my office and in the experimental room and testing laboratory. Mr. Venner was there at the factory, I know, during the time of those conversations in 1919, but whether he was there when I was talking to

Mr. Long, I don't know. I presume I did have a conversation with Mr. Long about these pistons at the door of the experimental laboratory in March, 1919. I don't remember, but I presume Mr. Venner was present at one of those conversations; that would be natural, because we were testing them in the laboratory at that time. Those tests were made under my supervision. I don't remember the man's name, that actually made the tests.

My memory is better now than it was six years ago, when I testified for Mr. Long, because I have reviewed the facts in the case more recently than I did then. I talked with the men at the factory about them, Mr. Castor for one. He is not in the Franklin factory now, by the way. He is in Jordan, a town outside of Syracuse. I also talked with Mr. Chadwick, Mr. Davis, Mr. Burns, and one or two men in the sales department of Franklin. The Mr. Chadwick of whom I speak is Frank Chadwick, who has charge of the records at the factory. Any difference between my testimony now and that which I gave in 1926 would be due to what these people told me, and the records which I looked over.

I couldn't say that it is a fact that the first pistons of Long that were tested at the Franklin plant were tested on October 5, 1918. My examination of the records and the talk with Mr. Castor did not refresh my recollection on that point. I think we made a report, somewhere, to the effect that in the first test made in the laboratory there on Long pistons, two of the pistons froze after running ten minutes. If there was a report to that effect, that was the fact. By "froze" was meant they stuck in the cylinders.

I don't remember any tests made of the Long pistons prior to October 5, 1918. In my examination of the records of the Franklin plant since the last time I testified here I found some records of tests on Long pistons other than this Exhibit Z, but I don't remember the date of the first one. The majority of them were after this date of Exhibit Z, but I couldn't say whether or not all of them were. Those records are now in the Franklin plant. I didn't bring any of them with me because I was not asked to. I think I mentioned to Mr. Bruninga that I had examined those records before I came here. There is one record that has been submitted there, that I think is before that date, and that is that drawing (indicating Exhibit BB) dated May 8th, 1919.

The drawing marked "Gulick Exhibit D-793-X" in the interference record, here marked for identification as Plaintiffs' Exhibit 1Z, is a design similar to the piston furnished the Franklin Company; it is similar to piston Exhibit B in this case. This drawing bears the date of February 11, 1919. The Franklin Company, in February 1919, was still working upon pistons like Exhibit B, trying to improve the design of them.

(At the trial, during the reading of the deposition:

By Mr. Richey: Now about these blueprints D-793-X, D-944-X, and D-960-X, I want to offer the same blueprints that were in the interference records and have them substituted for the lithographs, Defendants' Exhibit CC. These were the original exhibits in the Gulick interference and are Exhibits CC.)

I don't recognize the slot in the drawing marked "Gulick Exhibit D-944-X." It says that it is a proposed design for the Franklin Company, but I do not remember anything about it.

XQ. 215. I show you a drawing marked "Gulick Exhibit D-960-X" (included in Exhibit CC). Do you remember that as a proposed design of Franklin pistons?

Mr. Bruninga: I make the same objection to this procedure.

A. Yes, sir. That drawing is dated May 30, 1919.

(Narrative continued) I don't remember the date when it was proposed for the Franklin engine, and the date on that drawing does not refresh my recollection.

The Aluminium Castings Company of Cleveland, Ohio, made some drawings of proposed designs for the Franklin Company. I do not recognize the name of the checker on drawing D-960-X.

I saw some of the pistons, Exhibits E, F and G, before I made this drawing, Exhibit Y. The one I saw was Exhibit F.

The maximum speed at which these pistons reciprocated in the engine cylinder, at that time, was about a thousand feet a minute. I should say that speed has been increased since then. I should say that the engines were redesigned on account of the adoption of the aluminum piston. The R. P. M. of the engines using alu-

minum pistons was 3200 or 3300, and that is the maximum speed today. The maximum R. P. M. around 1926 was 2400 to 2600, I should say. I would say that the maximum pressure per square inch on the tops of these pistons, when the explosion takes place, is 350 pounds per square inch. In 1920, I guess, it was around 275. The length of stroke in the Franklin engine in 1920 was four inches.

Mr. McCoy: Tha. gives you an average travel of 1733 feet per minute. That would be much less than the maximum speed, I should judge, for 1920.

(Narrative continued) When I examined the records there at the Franklin plant since 1926, I did not find any definite records that I could offer as evidence, other than of the Long pistons like E, F and G. Long did submit to the Franklin Company other designs of pistons than those shown in E, F and G. I couldn't give you the dates of the records of Long pistons, because I didn't bring a record of those dates, and I don't remember them. I did not find anything earlier than March, 1919.

I have heard of Frank Jardine. I should think he is a well-known piston engineer, who has worked for the Aluminum Company for a number of years.

Mr. Bruninga: That is objected to as having no foundation in the direct examination.

I have also heard of Howard E. Maynard, a well-known automobile engineer, who worked for Chrysler Company for a number of years. I met him personally.

I have also heard of Louis P. Mooers, a well-known automobile engineer.

I don't know who suggested putting the three ribs in the top of the Long piston instead of one, and I don't know when that was first done. I know this Exhibit G has got them.

Mr. Richey: Cross examination closed.

RE-DIRECT EXAMINATION by Mr. Bruninga.

I make my living by doing consulting engineering work. I have an office, and office expenses. I also have living expenses. I have a wife and six daughters. I did not have to come here, but came at your request, as an accommodation to you.

In order to have the piston satisfactory in an operating engine, there has to be a certain amount of clearance between the piston and cylinders.

I cannot now describe the Kant Skore piston which was mentioned on cross examination.

The Mr. Maynard whose name was mentioned on cross examination is Howard E. Maynard. To my knowledge, he was with the Maxwell and the Chrysler Companies. He was with other companies before being with the Maxwell. The Maxwell Company is not now in existence. I can't remember when it went out of existence, though. I understand it was taken over by Chrysler.

I saw pistons of the general construction of the Maynard patent 1,655,968, a number of years ago. The pistons referred to in my testimony did not have that I-slot in them.

When I was called to testify in 1926 I had practically no notice; that is, I remember that Mr. Long wired me to come to Detroit and I left the same day, or, at least, that night. I had very little preparation to refresh my memory before I got on the witness stand. We discussed a few questions, as I remember it, before I went on the witness stand, but very slightly.

I did not talk with Mr. Venner about the evidence I was to give in this case. It has been several years since I have seen him. There is no reason why I did not talk with Mr. Venner about this case, in the last week, except that you asked me not to talk with other witnesses not directly, but impliedly. I understood that I was not to talk to any other witness.

At the time that we were discussing, the honing process had not been developed, that is, in a production way, in our factory, and the cylinders were more or less rough and lifted this grinding fuzz. The cylinders were more or less uneven, due to the very minute channel marks in the wheels, and then the wheels were apt to leave a slight fuzzy surface, it would be like, under the microscope. That, in our case, gave the pistons a tendency to score when the engine was first started up, after being assembled. That is true in other pistons besides the Long, but that difficulty appeared in the Long piston rather seriously, during our experimental work. As I have already testified, the clearances on Exhibit B were three thousandths at the bottom and nine at the top; and in Exhibit E they ran four thousandths all the way

up, the clearance being less on Exhibit E than on Exhibit B. It probably had an effect on the tendency to score, with a new piston.

The honing process considers the use of a hone or a stone rubbed up and down and circumferentially with the cylinder, so as to smooth or remove the grinding marks. We did not employ that honing process in 1920, nor did we employ it while I was with the Franklin Company. It was not used until after 1924.

I remember drawing D-739X (included in Exhibit CC'), as having been furnished to the Franklin Company by the Aluminum Castings Company of Cleveland, Ohio. I couldn't identify the date it was furnished, but I should judge that it would be around February 11, 1919. I understand the construction of the piston shown in drawing D-793X; it is practically the same construction as Exhibit B piston. I have an idea that the Aluminum Company furnished that drawing to the Franklin Company because they were asked to make a mold for that piston, or were asked to quote us on a mold for that piston.

I do not remember drawings D-944X and D-960X. The Aluminum Castings Company never furnished pistons to the Franklin Company, like D-944X or D-960X, to my knowledge.

The following statement, which was a fact, is contained in Defendants' Exhibit D: "The Franklin engineers, however, realizing the particularly desirable features of the aluminum alloy piston, have for the past three years, been conducting exhaustive experiments with the view of securing a design such that the undesirable features would be eliminated." The statement, "That has been accomplished" was also true at the date of this bulletin, November 11, 1920. The use of the Long piston was the method referred to in that bulletin. That Long piston was similar to Exhibit E.

As to the test of Long pistons in which two pistons froze, and referred to in my cross-examination, as I remember, that test was made on a block, with a motor on the block, having Long pistons in it, and it was run under very severe conditions, the pistons having set up under conditions that the regular production pistons at that time would not stand, without seizing. That test is referred to in Exhibit Z, my report of March 18, 1919. In the second sentence it says, "Several tests have been run in connection with this piston, the first being a set-

up test on the block with baffle plates under the cylinders which did not give a sufficient amount of oil so but what a set-up was obtained in about nine minutes. This was a more severe test than we ordinarily give our regular production pistons such as we are now using, and it is doubtful even if the pistons were undercut as we recommend them to be for use in the southwest would stand up under this test any longer than these pistons did."

Mr. William M. Venner developed a piston of his own. I saw some of those pistons at the Franklin plant, in Syracuse. They were an aluminum alloy, slotted type piston, and had the portions of the skirt being supported by a web running down from the head. That was, in general, his design. That was some time after, or about the time we adopted the Long pistons in production, I should say. We tested those pistons, as I remember, but were not particularly impressed with their performance as compared with the Long piston. Their performance was probably better than the performance of Exhibit B.

I should say Defendants' Exhibit K was a sketch of the piston that Mr. Venner furnished us for a test.

When I made Exhibit Y, during my direct examination, I did not look at either of the Exhibits B, E, F or G to make the drawing from. You put those pistons in a box.

I never met Louis P. Mooers. I do not know where he is now.

Mr. Bruninga: Re-direct examination closed.

RE-CROSS EXAMINATION by Mr. Richey.

Before I went on the witness stand to testify in the interference in 1926, I talked with Mr. Long and Mr. Fletcher, as I remember, or both of them. I do not remember anybody else with whom I talked.

In addition to being employed in this case in the manner we have talked about, only so far as to support my testimony, I have been employed to look up evidence for Defendant and interview other people about it. All my dealings in these matters have been with Mr. Bruninga. I have been told who the principal is.

EX. 8. You were told it was the Sterling Products Corporation, of St. Louis?

Mr. Bruninga: That is objected to as immaterial, at this stage of the proceeding.

Mr. Richey:

RX. 9. That is right, isn't it? A. Yes, that is right.

(Narrative continued) I expect Sterling Products Corporation to ultimately pay me for this work.

I can't tell you when I first saw pistons like shown in the Maynard patent, with the slot. I should say they have been on the market, with the slot in them, for a number of years, and in wide use, not only for replacements, but in production by a number of automobile companies. I don't think they were used with the slot in them by the Maxwell Company, but I am not sure of that to the extent that I could deny that they did have the slot in them.

I did not myself design any aluminum pistons, after the Franklin Company adopted the Long piston, with the idea of getting around the Long piston patents. I did design that oval piston, about which we talked yesterday, with the idea of getting out of paying a royalty. What I had in mind was, your first question related to Mr. Verner's piston, and that was more or less, to my mind, along the Long design. We didn't do any experimental work along that line, to get around the Long patent. We did use some oval pistons, which did not infringe or have anything to do with the Long patent. The oval piston is a trunk piston. We did experiment with the Long piston with the idea of improving upon it. I don't remember that we took out any patents on any aluminum pistons, after the Franklin Company adopted the Long piston.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

The date I had in mind with reference to the Maynard piston without the slot, was around 1919 or 1920. I should say that at that time it did not have a slot in it.

I haven't seen Mr. Long for a long time; I can't remember the date. It seems to me not since the last time I testified, in 1925, in that interference proceeding.

I have not as yet been paid anything in this proceeding, and I do not know where the money is coming from, but I look to you to see that I get it. I am willing to trust you to pay me for it.

Mr. Bruninga: That is all.

Mr. Bruninga: I offer in evidence the depositions of William M. Venner, Charles L. Chadwick, James V. Saxton, Charles F. Gilbert, Sidney D. Royalty, and Louis M. Stellman, as Defendants' Exhibit 3-Y. The exhibits attached have been offered in evidence.

Thereupon LOUIS M. STELLMAN, being first duly sworn, testified as follows:

DIRECT EXAMINATION by Mr. Bruninga.

Q. You are the Louis M. Stellman who has previously testified in this case, as in the deposition just read? A. Yes.

Q. And you were in the court room during the greater part of the reading of that deposition? A. Yes, sir.

Q. You stated in your deposition that you graduated from the University of Michigan in Mechanical Engineering; and will you give briefly the general course, just as brief as you can? A. The regular course such as the University of Michigan offered its students to get a Bachelor of Science Degree in Mechanical Engineering.

Q. Did that include drafting? A. Yes, we had some drafting work.

Q. Design work? A. Yes.

Q. Design of machinery and parts? A. Yes, sir.

Q. Can you read drawings? A. Yes, sir.

Q. Have you read patent specifications? A. Yes, sir.

Q. Do you understand them in connection with the drawings? A. Yes, sir.

Q. Do you know anything about claims of patents? A. Not particularly, no, sir.

Q. You are not a patent expert then, are you? A. No, sir.

Q. You don't claim to be? A. No, sir.

Q. Have you ever testified in any court proceedings at all except the Long interferences and this deposition that has just been read? A. No, sir.

Q. You are not a professional expert in law suits then, are you? A. No, sir.

Q. Do you remember whether there was one or more depositions in these Long interferences; in other words,

Louis M. Stellman, Direct Examination

did you testify just once, or a number of times? A. I testified once.

Q. Do you belong to the Society of Automotive Engineers? A. Yes, sir.

Q. Have you kept in touch with automotive engineers during the time you were with the Franklin Company and to date? A. More or less.

Q. What is your present business? A. Consulting engineer.

Q. Specializing in anything? A. In automotive equipment and engines in particular.

Q. You have received no medals, have you? A. No, sir.

Q. But you are the Louis M. Stellman to which the Court of Customs & Patent Appeals referred to as follows in 47 F. (2d) 369, at 370, the cause being Hartog v. Long, Interference appeal No. 2610: "Louis M. Stellman, a witness whose testimony displays an intelligent grasp of the situation, and who was at that time chief engineer of the Franklin Manufacturing Company." You are the one the court refers to? A. Yes, sir.

Q. I understood from your deposition you had experience with cast iron and aluminum trunk pistons? A. Yes, sir.

Q. Did that include the design and drawing of such pistons? A. Yes, sir.

Q. Have you had actual experience in the manufacture of such pistons? A. Yes, sir.

Q. And the machining? A. Yes.

Q. Have you ever had any machine shop experience? A. Yes, sir; before I went to college I had machine shop experience, and while I was in college. Of course since coming from college I have been intimately connected with machine shops and machine shop practice.

Q. You stated, I believe, that you took a student course at the Franklin Company. Did that include any actual machine work? A. Yes; when we left college we actually went into the shop and performed machine operations of various kinds.

Q. Have you had actual experience in the installation of pistons in automobiles? A. Yes, sir.

Q. Both aluminum and cast iron? A. Yes, sir.

Q. Have you had experience with the actual testing of aluminum and cast iron trunk pistons in automobile engines? A. Yes, sir.

Q. Did that include block tests? A. Block tests and road tests.

Q. Will you describe the general structure of a trunk piston as it existed in the beginning of 1915 in this country? A. A trunk piston had a head and a skirt integral with the head, attached to it were wrist pin bosses. In the head were grooves for slots in which piston rings were installed.

Q. Where were the bosses located in those pistons?

A. In the inside of the piston skirt.

Q. Will you tell me whether there was any ribbing or webbing on the inside of such a piston and if so please describe it. A. There were ribs inside, often times running from the head to the wrist pin boss, to help support the boss. Other ribs in the head to stiffen the head and to help cool the head.

Q. How did that construction in use in 1915 compare with what is shown in Defendants' Exhibit M? A. I should say that was the fairly standard type of trunk piston.

Q. It had that web going across the head and extending down to the wrist pin bosses? A. Yes, sir.

Q. What was the diameter of the head with reference to the skirt in those pistons in 1915? A. The head down by and including the ring lands was usually several thousandths smaller than the skirt.

Q. And how was the skirt constructed? Was it cylindrical, straight up and down, or was it tapered? A. Why, often times it was tapered, being largest at the bottom and smallest at the top just below the ring lands.

Q. And was that the practice with the Frank Company in the beginning of 1915? A. Yes, sir.

Q. How about the ring, the wiper ring I, as shown on Plaintiffs' Exhibit 14; what was the practice in the beginning of 1915? A. Wiper rings of that type were often used to reduce oil consumption. The Franklin Company didn't use it at that time, however.

Q. Did you see it in use? A. I have seen it in use.

Q. What have you to say about the relieving, the practice of relieving the piston in the region of the wrist pin bosses on the outside? A. It is common practice to relieve pistons around the end of the wrist pin boss on the outside of the skirt.

Q. What was the extent of the relief? A. It varied from a few thousandths to a cast-in relief of quite considerable depth.

Q. How long has that been common practice? A. Back to 1909, I should say, from experience, and even farther back.

Q. And was that sort of relief employed at the Franklin Company? A. Yes, sir.

Q. When you came there? A. Yes, sir.

Q. When you say that relief was cast in, what do you mean by that? A. The portion of the piston skirt directly around the end of the wrist pin boss was so cast that after the piston was machined, that surface was left rough, that is, the bottom of the relief was rough and not machined.

Q. How did such a relief compare, for instance, with Exhibit 3-H? A. Exhibit 3-H, I would say was a machined relief of comparatively small depth, that is, the bottom of the relief would probably be maybe a sixty-fourth of an inch below the cylinder wall as the piston was installed in the cylinder, while the cast relief would often times be deeper because of the irregularities of the cast surface.

Q. Are you familiar with the slipper piston, such, for instance, as the Ricardo and the Jardine pistons? A. Yes, sir.

Q. I mean the general structure? A. Yes, sir.

Q. What have you to say about the relief in those pistons? A. The design of that piston is such that the piston is automatically, actually has a large relief at the ends of the wrist pin bosses.

Q. In other words, that is an extreme relief? A. The wall is actually removed at that portion of the skirt.

Q. Now, you testified with reference to oval grinding and with reference to a particular oval piston. Where was the major axis of that piston? A. The longest axis was perpendicular to the plane of the wrist pin, the shorter axis being parallel to the wrist pin.

Q. What was the purpose of that oval construction as far as relief was concerned? A. That formed a relief at the end of the wrist pin.

Q. Would you say that was the equivalent of the relief? A. I should say so.

Q. What is the purpose of relieving the piston in the region of the wrist pin bosses? A. In cast iron pistons, I should say the purpose was to provide for a certain distortion of the piston skirt at the end of the wrist pin boss, so that there would not be undue friction between the cylinder wall and the piston at that point with the consequent scoring and trouble.

Q. Did it have anything to do with reference to expansion? A. Yes, sir. Of course it was not desired particularly to fit the piston tight in that direction because of expansion, and you could therefore give the relief there and allow for expansion in that direction.

Q. How about a piston that had a rib going across the top of the piston and connected with the wrist pin bosses; what effect did the relief have when such a construction was used? A. It took care of the expansion, which was rather great at that point, due to the rib, and also took care of the stiffening of the piston, due to that rib.

Q. Was that understood in the beginning of 1915? A. Yes, sir.

Q. Do you know whether any lightening of skirt was resorted to at all in the beginning of 1915; I don't mean necessarily in the Franklin plant; but as it came to your observation? A. It was of course considered desirable to make a piston as light as possible even in 1915.

Q. Was the cutting of holes ever resorted to? A. Yes, sir.

Q. What have you to say about the slipper type piston so far as securing lightness is concerned? A. Why, one would think with proper design the slipper type piston could be lighter than the ordinary trunk type.

Q. Do you know anything about the expedient of placing the oil groove below the lowest ring land in a Franklin piston? A. That was a common expedient: The oil groove just below the lower ring, with holes drilled through the surface of the piston to the inside.

Q. How early was that practice? A. I should say as early as 1909 that was done, 1910.

Q. Was that practice at the Franklin Company before you ever adopted the aluminum pistons? A. Yes, sir.

Q. You say that groove was perforated? A. Yes, sir.

Q. What was the purpose of perforating such a groove? A. To allow the oil to pass from the outer piston wall to the inside and back to the crank case.

Q. The Maynard patent shows the ring land J below the lowest ring reduced in diameter. Do you know what the purpose of that is? A. That was to provide a space for oil to gather and to pass from that space back into the inside of the piston, I should say.

Q. Was that practiced at all at the Franklin Company? A. Yes, sir.

Q. How early? A. Why, as early as 1910.

Q. I hand you United States patent to Howe 908,569. Have you read that patent? A. Yes, sir.

Q. Can you describe what you understand the purpose of that construction as described, is? A. That is the construction we have been talking about, with a circumferential oil groove just below the lower ring, having holes from the bottom of the groove to the inside of the piston for the drainage of oil from the outside of the piston below the lower ring to the inside.

Mr. Bichey: I don't know what the purpose of producing this patent is, but I object to it on the ground that it is not set up in the answer, if you intend to rely upon it as a defense.

The Master: Same ruling.

Q. Where is the groove shown in that patent? A. It is shown slightly below the lower ring in the circumference of the piston wall.

Q. And the holes are in that; is that right? A. That is right.

Q. What is the diameter of the lowest ring land E with reference to the other ring land above it? A. The land E of the piston is reduced in diameter as compared to the other ring land.

Q. You say that was common practice then as early as what? A. As early as 1910, I should say.

Q. Only in the Franklin automobile? A. No; in general.

Q. What is the purpose of the rings on a trunk piston? A. The rings are used to seal the piston and the cylinder, the space between the piston and the cylinder, against the passage of explosion gases going down and against the oil working up.

Q. Those rings are split, are they not? A. They are usually.

Q. How long has that been the practice of splitting piston rings? A. Ever since they have been used; I should say for a good many years.

Q. Were they in use when you came to the Franklin Company? A. Yes, sir.

Q. And they are split for the purpose of permitting them to expand and contract; is that right? A. That is right.

Q. If they were not split, what would happen if the piston and the rings heated up? A. The rings would not follow the cylinder wall and of course would not form a seal.

Q. Well, if the rings were of the same diameter as the cylinder or were a few thousandths less when cold and then the engine heated up, what would happen? A. The rings would become larger than the cylinder and score or break.

Q. But if they are split, that will not happen? A. That will not happen.

Q. Do the rings perform any function at all of conducting away the heat to the cylinder wall? A. A very great amount of heat is conducted through the rings to the cylinder wall.

Q. Have you any figures on that at all? A. In airplane practice we considered that 90 per cent of the heat that the piston had was conducted through the rings to the wall.

Q. Have you ever had experience in airplanes? A. Yes.

Q. What has been your experience? A. I was with the Wright Company, a subsidiary of Curtiss-Wright, in their engineering department for about a year and did some consulting work after that with them, and had continual experience in connection with the building of airplane motors, which was the product they manufactured.

Q. What do you base your statement on about 90 per cent being conducted? A. That was the findings of the experiments and tests which they made and the general consensus of opinion of the engineers at that plant.

Mr. Kichey: I object to the latter part of the answer as hearsay and speculation.

Q. But that is your opinion, is it? A. Yes, sir.

Q. Based upon experience? A. Yes, sir.

Q. On data that you know about? A. On tests and general use of the piston.

Q. Now, what is the effect if a piston skirt has a large clearance? A. Of course, in connection with airplane motor pistons it was customary and still is to use an ordinary trunk aluminum piston, which had to be given a rather large amount of clearance compared to the automobile practice, and the difficulty encountered with pistons having a large amount of clearance between the skirt and the cylinder wall was that we had considerable cocking of the piston in the cylinder which when it be-

comes too great, allows the rings to fail to function to a certain extent, which in turn allows the explosion gases to blow by the rings, heating the piston unduly in the cylinder wall, and it also allows the oil to work up by the rings into the combustion chamber to an excessive degree.

Q. The cocking of a piston is in a plane of the connecting rod, referring, for instance, to Exhibit 14? A. Yes, sir.

Q. And in order to overcome that it was simply necessary to support the piston on the thrust side? A. That is right, on the two thrust sides.

Q. What was the clearance of iron pistons in the Franklin car; you may give the diameter of the piston. A. In a $3\frac{1}{4}$ " bore, that is a piston having an over all diameter of approximately $3\frac{1}{4}$ ", we used to allow two to three thousandths clearance between the skirt and the cylinder wall, on the diameter.

Q. Was there any call for compensation for clearance? A. Yes.

Q. Well, I mean so far as splitting was concerned in a cast iron piston? A. No.

Q. Was it necessary at all to do so? A. "We didn't split the cast iron piston.

Q. Did you ever have to provide compensation for clearance; that is, automatic compensation by, for instance, splitting or some other means? A. No. The problem of clearance was small enough in the case of the use of the cast iron piston so the split pistons were not desirable or were not necessary.

Q. Do you know of any cast iron piston to-day that is split? A. You have one exhibit here in court.

Q. Yes, but I mean in practice, the motor practice? A. In an automobile, no.

Q. In other words, the cast iron piston to-day is used without any splitting or any other compensating means but the straight trunk type? A. It could be.

Q. Just relief opposite the wrist pin bosses? A. Yes, sir.

Q. When you come to aluminum pistons, aluminum has a greater co-efficient of expansion than cast iron, has it not? A. Yes, sir.

Q. In other words, a piston of say $3\frac{1}{2}$ " diameter of aluminum would expand a good deal faster under the same conditions than a cast iron piston; is that right? A. That is right.

Q. And that requires greater clearance, if you have nothing else at all? A. Yes, sir.

Q. What happens then, if you provide the same clearance in an aluminum piston as you do in a cast iron piston in the same engine? A. If you use the same clearance in aluminum as in a cast iron piston, the piston would probably stick, if the cast iron piston had a satisfactory, small running clearance.

Q. And that problem was encountered when aluminum pistons came into use; is that right? A. Yes, sir.

Q. You have heard Dr. Jeffries say that that was around 1915. Is that your recollection? A. Yes, sir.

Q. There was then no call for providing any compensation for expansion by splitting or otherwise until aluminum pistons came into use; is that right? A. That is right.

Q. You faced that problem I understood from your deposition, when the Franklin Company put in aluminum pistons? A. Yes, sir.

Q. And you tried it with a straight trunk piston first? A. Yes, sir.

Q. And you found out you couldn't operate at the same clearance; is that right? A. As with cast iron, yes.

Q. Now, who designed Exhibit B? A. I did; that is, it was designed under my supervision.

Q. But who conceived the idea, as far as you are concerned, of putting slots in that piston? A. I did.

Q. Why did you put them in? A. To provide flexibility at the bottom of the skirt so that we could run the pistons with closer clearance than with the unslotted ordinary trunk type piston.

Q. Did anybody have to tell you to put slots in that piston in order to compensate for expansion? A. No.

Q. You saw the piston rings right above it, didn't you, that were split?

Mr. Richey: I object to that as leading.

A. Yes.

Q. Do you think you displayed an extraordinary amount of ingenuity by putting those slots in that exhibit?

Mr. Richey: Object to it as immaterial.

The Master: He may answer.

A. I never thought it was a very great trick.

Q. When you said that compensation for clearance by splitting or other means was not necessary when cast iron pistons were used, did you have in mind pleasure cars or racing cars? A. Pleasure cars.

Q. What is the condition in a racing car? A. Conditions are much more severe in the racing car than in the ordinary pleasure automobile because of the fact they are driven with wide open throttle practically continuously.

Q. Do you remember what speeds cars were designed for in 1911? A. 50 miles per hour was considered a very high speed for passenger cars in 1911.

Q. And pistons did not seize with the clearance that you used at that time, cast iron pistons didn't seize? A. I wouldn't say they never seized, but it wasn't a common difficulty.

Q. What was your opinion as an engineer if the speed was stepped up to 70 miles per hour? A. The conditions are very much more severe under the higher speeds for pistons in an automobile engine, very much more severe at 70 miles than at 50 miles, because of the heat transmitted from the gases to the pistons.

Q. Was there any utility at all in splitting a piston for a racing car designed say, for fifty miles an hour, and operating at 70 miles an hour? A. I should think there might have been, yes, sir.

Q. If a racing car in 1911 with a piston, say $4\frac{1}{2}$ " in diameter, four-cylinder engine, such as the car that Mr. Monckmeier testified about, had a clearance very much greater than the clearance in use in the ordinary car, in what way was the efficiency affected? A. Well, of course, if the clearance was too great in a racing car, you would have trouble with cocking the piston and blow-by the rings, excessive oil consumption, and so forth.

Q. Would the blow-by the rings affect the power that the engine could deliver? A. Yes. The blow-by the rings would affect the power at all speeds but more at high speed than low. It also has a tendency and does heat the piston and the piston wall seriously.

Q. You have attended automobile races, have you? A. Yes.

Q. Isn't it rather important that there be a pretty quick start? A. Yes.

Q. Do you think the equipment of an automobile in 1911 with $4\frac{1}{2}$ " diameter pistons, four-cylinder, with split skirt pistons to permit compensation for expansion, was of any utility in a racing car designed to travel at fifty miles per hour and actually run at seventy miles an hour? A. I should say it would allow them to fit the pistons with less clearance, and the same clearance with less

drag on the cylinder walls, and would give some additional speed.

(Noon recess.)

(Thereupon, at 1:30 P. M., Monday, January 30, 1933, the hearing was resumed.)

Q. Have you examined the two large $4\frac{1}{2}$ " pistons, Defendants' Exhibits 3-V and 3-W? A. Not carefully, no.

Q. First examine 3-V. A. (Witness complies.)

Q. In a piston of that diameter, and 6" stroke, in a six-cylinder car as it existed in 1912 or '13, was there any utility or any advantage in having a slot as illustrated in that piston when used in a racing car traveling for instance at 70 miles per hour? A. I should say there was, yes.

Q. I notice that on one side the slot was not cut entirely through at the top. Does that tell you anything as to what kind of a tool might have been used for cutting that slot? A. I should say it might have been cut with a miller.

Q. Now, a miller is a round wheel, isn't it, a round cutting wheel? A. Yes.

Q. And if the miller was run right close up to the head, it would be liable to cut through into the ring land, isn't that right? A. Yes, if it was of too large a diameter.

Q. Do you know whether an operation like that sometimes happens, that a part is left in accidentally? A. Yes.

Q. In your opinion would it affect the utility of that piston to such an extent as to make it not useful at all in a racing car? A. No, especially as the slot on the opposite side seems to be cut all the way through from the bottom to the top, to the horizontal slot below the ring land.

Q. With a clearance of .015",—I believe that is what Mr. Monekmeier stated—would that piston operate more effectively in your opinion with it slotted? A. Yes. If as he said there apparently was some drag with .015" clearance without the slots.

Q. Now, this aluminum piston, Exhibit 3-W, have you examined that piston? A. Yes, sir.

Q. Does it look to you as if it has gone through a fire? A. I should judge it had been pretty hot.

Q. Will the skirt of that piston have any flexibility?

A. Yes, it would.

Q. I notice that the horizontal slot is not right directly below the ring land. Do you see any reason why, in your opinion, why it might have been placed lower?

A. One reason is the slot comes as near the piston head as it can on the inside because of the thickened portion of the head above the slot; also there is the relief around the piston at the point of the circumferential slot and slightly below.

Q. What is the effect of that relief? A. The relief is to allow plenty of clearance at the top of the skirt, above the slot.

Q. Where is the clearance, where is compensation for clearance, or clearance, mostly desired in that skirt?

A. The portion of the skirt nearest the head.

Q. By "relief" you meant that circumferential band all around the piston; is that right? A. Yes.

Q. Can you tell whether or not that particular piston had a T-slot on the other side, from the character of the break? A. I should say it had a T-slot on both sides.

Q. What makes you say that? A. Because there is a circumferential slot, portions of it left on the broken-away side the same as on the side opposite.

Q. How about the little notch nearest the top, about in the middle of that circumferential slot; what does that indicate? A. It probably shows the milling cutter that cut the vertical slot struck that portion of the metal.

Q. Do you think a milling cutter was used on that particular piston? A. Whatever they cut it with. That was a hack saw. I think he testified it was a hack saw.

Q. In your opinion is there any utility added to that piston by slotting it with a T-slot, I am referring now to Exhibit 3-W? A. I should say there was.

Q. Do you think there was any utility by using that sort of a construction in a racing car, six-cylinder racing car of 4½" diameter and a 6" stroke? A. No doubt of it in my mind.

Q. I hand you a copy of the Van Bever patent 1,031,212. Will you briefly describe in what way that distinguishes, if at all, from the ordinary trunk piston? A. You note on the drawing of Fig. 1 they show some slots running from the open end of the piston through the piston skirt up to the center line of the wrist pin, and the same is shown on Fig. 4. There are evidently four of

these slots, two on each side of the plane through the wrist pin. This allows the bottom of the skirt to expand and contract with reference to the cylinder wall.

Q. What is the part 17 in Fig. 1? A. That is an expanding ring.

Q. What is the purpose of that expanding ring in that Van Bever construction? A. To expand the slotted portion of the piston. As I understand it, his idea was to take up for wear of the cylinder.

Q. In other words, as the cylinder got larger he could positively expand that and take up for wear, is that the idea? A. That is it.

Q. But if you take out that expander entirely, what would happen then if the skirt were made out of either metal or aluminum? A. If the skirt were made out of what?

Q. If the skirt were made out of either metal or aluminum, what would happen as far as expansibility or contractability were concerned, if that expander were taken out? A. Well, if the piston expanded itself so as to become larger than the cylinder, these slots would automatically allow the piston to contract at the bottom of the skirt.

Q. In what respect is that distinguished from Exhibit B? A. Very much the same idea as in Exhibit B.

Q. And you left the expander out of Exhibit B, that is the positive expander? A. We did in production, yes.

Q. In other words, the omission of that expander and its function would produce Exhibit B, is that right? A. Yes.

Q. And that would be true, the springing action would be true, whether the piston were made out of cast iron or aluminum? A. Yes, sir.

Q. I call your attention to the Rainforth British patent 6826 of 1912. Have you read that patent? A. Yes, sir.

Q. Will you briefly describe its construction? A. This is a patent on a more conventional form of trunk type piston, except that the bottom of the skirt has vertical slots slotted through a portion of the piston which is evidently the portion intended to bear against the cylinder wall. These slots, as I understand the description, could either run as shown on the drawing, or the two Figs. 1 and 2, or the bottom of the slot could extend through the open end of the piston. This would allow the piston to have much the same action as we obtained with Exhibit B with the slotted skirt.

Q. What is the part, the band A in that British patent? A. That is a relief around the wrist pin and up pretty well toward the cylinder head.

Q. Well, if the slots D terminated as shown in Fig. 1, but started above the enlarged part and in the relieved part A, what have you to say about the working of that piston then? A. Well, it is evident to me that this piston was made so that the portion of the skirt between A¹ and A², can contract or expand, inasmuch as the slots run to the relief above this portion and also in the relief below the portion of the skirt that is slotted.

Q. I notice that in Fig. 2 the slots are at an angle. What is the useful function of that, if any? A. I think the idea was to have the slots, the ends of the slots overlap each other, so there would be no ridge or rib left inside on the cylinder wall due to wear.

Q. The specification, page 1, lines 12 to 14, reads as follows: "One or more slots may be used each of which may have both its ends closed and they may be made with their general direction along the length of the piston." What do you understand by that, that a number of slots have to be used, a large number as shown in the piston? A. It says, "one or more," not necessarily a large number, I should say.

Q. I now call your attention to the Vincent patent, 1,279,184. Have you read that patent? A. Yes, sir.

Q. Do you know who Jesse G. Vincent was at that time? A. Engineer for the Packard Company.

Q. He was chief engineer for Packard Motor Company, wasn't he? A. Yes.

Q. And the designer of the Liberty Motor? A. One of them, as I understand it.

Q. Now, in what respect does Fig. 7 construction on the second sheet differentiate from Exhibit B? A. I should say that it was essentially the same design except that the vertical ribs run farther along the piston skirt, that is, higher up on the skirt, more nearly approaching the ring lands.

Q. What is the part 15a? A. I judge it is an expanding ring, yes, an expanding ring in the bottom of the piston.

Q. Do you know whether that is a positive expanding ring, as described in the Van Bever patent, or is it a yielding one? A. A spring ring.

Q. How does that compare with the expanding ring you used in Exhibit B? A. Very much the same except

the cross section of our ring was circular instead of rectangular.

Q. Now, in this Vincent patent there is no specific description of a relief opposite, in the region of the wrist pin bosses. Would you expect that to be repeated in every patent from the beginning? A. No, I think that was the general practice, and more or less taken as an obvious construction necessary to make the piston perform satisfactorily.

Q. I next call your attention to the Schoengarth patent 1,174,002. Have you read that patent? A. Yes, sir.

Mr. Richey: Just a minute before you answer that. That is not set up in the answer. We object to that.

The Master: Same ruling. He may answer.

A. Yes, sir, I have read this patent.

Q. Describe that patent construction. You don't need to describe the engine, but the piston construction for instance as shown on Figs. 2 and 3? A. This piston is evidently a trunk type piston with a T-slot, or what might be called a Z-slot. The difference between this and the conventional T-slot being that the vertical portion of the slot runs on a distinct angle, on the piston wall, rather than vertical with reference to the horizontal slot.

Q. What relation if any does the particular slotting have to the T-slot piston such as shown in the Monckmeier pistons Exhibit 2-V and 2-W? A. I should say that the slot was such that the piston functions very much the same as one with a T-slot.

Q. Now, there is an expanding device shown on the inside for positively expanding that piston. Do you know what the purpose of that is? A. That was to allow the piston to be adjusted for cylinder wall wear by expanding the piston out against or toward the cylinder wall.

Q. Do you know what relation if any the piston illustrated in Figs. 2 and 3, that is, I mean now general construction, bears with a Ford piston in use at that time, in 1915, the Model T? A. Well, I don't think that the Ford piston had any slots in it at that time, but in general construction I should say it was generally that same piston without the slots.

Q. Now, the horizontal of the T-slot combination, where is that with reference to the bottom ring lands? A. Slightly below the bottom ring lands.

Q. And with reference to the wrist pin bosses? A. Well, above the wrist pin boss.

Q. Well, is it between or on a line with them? A. Circumferentially, you mean?

Q. Yes, circumferentially, is it in the region between? A. It is between but extends to the wrist pin bosses.

Q. Would you expect that relief to be shown on this piston? A. No. As I have already explained, relief around the end of the wrist pin was common practice at that time and would be expected. This piston would be expected to have one of some kind.

Q. What would happen if you didn't have a relief? A. Get scoring around the end of the wrist pin boss.

Q. Now, the patent says specifically "adjusting devices for adjusting the piston in diameter." Suppose that those adjusting devices are simply taken out, left off, how would that piston function then, if placed in a cylinder? A. You would have an automatically expanding and contracting skirt below the wrist pin lands.

Q. And if it had the reliefs in the region of the wrist pin bosses, in what way would its structure and mode of operation then distinguish from Defendants' Exhibit CCC, both if the adjusting devices were omitted and it had reliefs? A. I should say the mode of operation would be essentially the same as in the piston shown in Defendants' Exhibit CCC.

Q. What have you to say with reference to Defendants' Exhibit BBB? A. The same statement would apply.

(Short recess taken.)

Q. I hand you a piston which I will mark for identification Defendants' Exhibit 3-Z. Do you know what kind of piston that is? A. Yes, that is a Kant-Skore aluminum piston, I should say.

Q. Do you know what the name of the Kant-Skore Company is now? A. Aluminum Industries, I believe.

Q. How does that particular piston compare with the Schoengarth patent 1,174,092, I mean in a general way as to method of slotting? A. The slotting shown in the Schoengarth patent is somewhat similar to that on the Kant-Skore when one side of the piston skirt only is taken into account.

Q. How does that Kant-Skore piston compare with the Spillman Patent, 1,325,176? A. It is very similar to the Spillman patent.

Q. I notice that Kant-Skore piston has reliefs in the region of the wrist pin bosses. Can you tell by look-

ing at it whether those are cast in or machined in? A. Cast, I should say.

Mr. Richey: I will object to this piston and this patent both on the ground they are not set up in the answer.

The Master: Same ruling.

Q. How many slot combinations are there in that Kant-Skore patent? A. Kant-Skore piston, you mean?

Q. In the Spillman patent? A. There are two slot combinations in the Spillman patent. What might be called Z-slots or T-slots, one on each side of the piston skirt.

Q. The difference between the Kant-Skore piston and the Spillman patent on one side, and the Schoengarth patent on the other, is that there is only one slot combination on one side of the piston and that the extending along the piston starts from the middle of the circumferential slot rather than one end? A. That is right.

Q. I call your attention to the Long patent 1,395,441. Have you read that patent? A. Yes, sir.

Q. Will you briefly describe its construction, more particularly with reference to the side shown in Fig. 2? A. That shows a trunk type piston with a T-slot in the side. The circumferential slot forming the top of the T being slightly below the lower ring land. In this is also mentioned the fact that the portion between the T-slot and the lower ring land is or may be relieved so as to create a clearance above the T between the piston and cylinder wall.

Q. I call your attention to page 2, line 4, *et seq.* of the patent, which reads as follows: "In a piston of this improved character it is preferable to have the solid end 1 of the piston of a lesser diameter across the peripheral surface adjacent the piston ring recesses 2 than the remaining lower portion of the piston, said lesser diameter adjacent the solid end of the piston not being considered relative to this improved invention, as the usual type of piston rings mounted in the recesses will automatically take care of the proper expanding, contracting and packing relation relative to said solid piston end." What have you to say with reference to that description and with reference to the part above the slot 9a, as to what its diameter is? A. I understand that that diameter is smaller than the piston skirt, perhaps the same size as the ring lands above this portion of the skirt.

Q. In what way are the wrist pin bosses mounted in that skirt? A. As shown in Fig. 3 they are evidently

mounted on the side wall of the piston, and with the ribs running from the head of the piston to the wrist pin boss.

Q. Fig. 1, as I understand it, is a view from the reverse side of the piston than in Fig. 2. Can you just briefly describe that construction? A. Fig. 1 shows that the side of the piston on the reverse side from the T-slot is slotted so that there is a tongue formed by what might be called U-slots, the free end of the tongue being at the top of the piston skirt. Beside this tongue there is a slot running from the bottom of the skirt up into the tongue, making that side of the skirt rather flexible.

Q. The description, page 2, line 41, *et seq.* reads as follows: "As shown more clearly in Figs. 3 and 5, enlarged portions 12, each of which is reinforced by the rib 13, are provided for reinforcing the bearings formed by the wrist pin openings 10." What is the purpose of the pad 12 of the inside of that skirt, or rather the two pads shown in Fig. 5? A. The purpose of this rib is to reinforce the wrist pin boss and carry the load of the piston down to the piston head.

Q. Why do you think those were placed in there? A. Simply to rib up the boss and keep it from springing.

Q. Does the cutting of the slots 9a and 5 have anything to do with the provision of that rib? A. Yes, in a way it would make the side of the piston wall more or less flexible and call for a rib to support the piston boss because of the flexibility of the walls, perhaps.

Q. Look on the inside of Exhibit BBB and Exhibit CCC. What have you to say with reference to those inside reinforcements? A. I should say these wrist pin bosses were ribbed much the same way that they are in the Long piston shown in patent 1,395,441.

Q. I note again that the drawings of this Long patent do not show the relief in the region of the wrist pin bosses. You don't find that illustrated? A. No, sir. That evidently was not considered necessary in the patent drawing, although usual in performing the actual operation.

Q. Well, if you had a drawing of a piston like that before you, what would you say as to the construction on the outside in the region of the wrist pin bosses? A. I would think it would have to be relieved.

Q. How with respect to BBB and CCC? A. That would be a satisfactory relief on such a piston as shown in the drawing.

Q. And I understood you to say that was the usual thing in pistons at that time? A. Yes, sir.

Q. And I understood as far back at least as the early part of 1915, is that right? A. Yes, sir.

Mr. Richey: Oh, don't lead the witness.

Mr. Brunnings: He said that. I just want to connect it up.

The Master: I think he testified to that before.

Q. Now, in what way does Fig. 2 of the Long patent differentiate from Fig. 2 of the Schoengarth patent, if we eliminate the inside adjustments? A. Well, Fig. 2 of the Schoengarth and Fig. 2 of the Long are similar in that the side of the skirt has a T-slot in each.

Q. But the T-slot is vertical in the Long patent but on a slant in the Schoengarth patent; is that right? A. Yes.

Q. I want to call your attention to the Long patent 1,489,499. Have you read that patent? A. Yes, sir.

Mr. Richey: I object to that as not set up in the answer.

The Master: Same ruling.

Q. Will you briefly describe the construction of that Long patent?

Mr. Brunnings: It is to be noted here that counsel called this witness' attention to that patent during the taking of the deposition.

Mr. Richey: Not for the purpose of assailing the validity of any of the patents in suit.

A. This patent covers a slotted piston, one side, as shown in Fig. 2, having what is known as a tongue with two vertical slots, one on each side of the tongue, running into a horizontal slot below the lower right lands. On the other side of the piston there is a section of the skirt cut away by a system of vertical and horizontal slots, this section being supported by ribs running to the wrist pin bosses. This makes that portion of the wall flexible, and also the portion on the other side of the tongue is more or less flexible, above the slots, the horizontal slots, that portion of the piston is really of the same diameter, apparently, as the ring grooves, so that there will be no bearing on that portion on the cylinder wall during the operation of the piston.

Q. Referring to Fig. 5, which is a cross section, what parts are flexible? A. The parts 8a are supposed to flex, I judge.

Q. Do you think they would flex?

Mr. Richey: I object to that as leading.

A. I don't think that would be a very flexible construction, if that is what you mean. Perhaps—I understand it is the idea of the patent.

Q. But I am asking your opinion, with the construction shown in Fig. 5, will the webs 8a flex? A. Yes.

Q. How will they flex? A. When the piston shoves out against the cylinder wall, that portion of the skirt, of the webs, will bend.

Q. Away from each other? A. Yes, away from each other on the outside, the outer end of the skirt—outer end of the ribs.

Q. What happens to the intermediate part 4? A. That has to more nearly assume the straight line as the arc of the circle becomes greater.

Q. What are the slots 5-5 for? A. To allow this to happen, to take place.

Q. I call your attention to the Long patent 1,872,772. Have you read that patent?

Mr. Richey: I object to that as not set up in the answer.

The Master: Same ruling.

A. Yes.

Mr. Bruninga: I want to call your Honor's attention to the fact, as far as Mr. Long was concerned, he was set up as a prior inventor and prior user, and all of that. I want to also call your Honor's attention to the fact that the application for this particular patent, and the first Long patent, were in interference with the Jardine application of the patent in suit.

Mr. Richey: Also the Gulick.

Mr. Bruninga: Also Gulick.

Q. Compare the structure of this patent with Defendants' Exhibit F? A. I should say that Defendants' Exhibit F was essentially the same construction as shown in the Long patent 1,872,772.

Q. I note that the slot 9, or rather two slots, don't go all the way around Exhibit F. Is that a distinction?

A. These slots don't go all the way around? You mean in the drawing?

Q. In the drawing, don't go all the way around.

A. No, as far as the operation of the piston is concerned,

I shouldn't say there was a distinction. That is a fact, however.

Q. How about the reliefs on Exhibit F; they are not shown on the drawings? A. The reliefs around the end of the wrist pin boss is not shown on the drawings, although there is a relief on the actual piston, Exhibit F.

Q. Well, how about those pistons that Long brought over to the Franklin Company that you have testified about, particularly like Exhibit F. Can you state anything as to the relief? A. Yes, he had the relief around the end of the wrist pin boss.

Q. How does Exhibit E compare with that Long patent? A. In principle, I should say the piston shown in E was the same as shown in the patent. There is some difference in the internal ribbing between the head and the wrist pin boss.

Q. There are three ribs instead of one, is that right? A. Three ribs instead of one.

Q. The relief in Exhibit E, that is cast in, isn't it? A. That is right.

Q. I notice also the slots on the outside corresponding to 8-8 in the patent are inclined in the Exhibit E; that is another distinction, isn't it? A. Yes, but that would not affect the operation of the piston as I see it.

Q. Now, what have you to say about Exhibit G, in what way is that distinguished from the Long patent? A. That is practically the same piston as shown in that patent.

Q. How about the reliefs? A. The reliefs are cast in.

Q. How about the internal ribbing? A. It has three ribs instead of one, as shown in the patent.

Q. How about the large relief right underneath the head of the piston? A. That is cast in.

Q. Do you know what the purpose of that large relief was? A. Simply to allow the tool to run out there and not to give a sharp corner at that point, I judge, in the supporting member to the wrist pin boss; also saves weight.

Q. I call your attention to British patent to Hives, 140,988, accepted April 8, 1920.

Mr. Richey: I object to that as not in the answer.

The Master: Same ruling.

Q. Have you read the specification of that patent? A. Yes, sir.

Q. Can you briefly describe that piston? A. That is essentially a trunk type piston with a T-slot on one skirt. This T-slot is described as being used to run from the open end of the skirt to the horizontal slot or to stop in another slot, near the lower edge of the piston, as shown by the dotted lines in Fig. 1.

Q. I want to call your particular attention to page 1, line 33 et seq., reading as follows: "The effect of such saw cuts is to give an elasticity to that part of the skirt between the circumferential saw cut and the edge, or between the two circumferential saw cuts as the case may be, and thus enable us, as we do, to machine that part slightly oval so that when cold the piston is held in close contact with the other side of the cylinder, and yet when heated that part of the skirt can contract and avoid risk of seizure." Can you tell us what your understanding is of that matter, as one skilled in the piston art? A. I understand from this description that this piston was mounted and ground so that the section taken through the skirt, as shown in Fig. 2, would be slightly oval shaped, the large diameter being on a diameter perpendicular to the wrist pin, the smallest diameter of the oval being parallel to the wrist pin.

Q. What would that give in the region of the wrist pin bosses? A. That would give relief in the region of the wrist pin bosses.

Q. Where would the ends of the horizontal slot run with reference to the skirt? A. The ends would be in the relief portion of the skirt.

Q. How does that operation compare with the oval grinding that you have referred to in your deposition?

A. It would give a piston of an oval shape similar to that used by the Franklin Company.

Q. And what have you to say about a relief such as shown for instance in Exhibit CCC, or Exhibit BBB, and the oval relief of the British patent; how do they compare? A. The oval relief would perform much the function as the cast-in, or machined relief which is on Exhibits CCC and BBB.

Q. Can you tell me whether or not the reliefs would be equivalents?

Mr. Richey: I object to that question as leading.

The Master: Same ruling.

A. I would say they would, yes.

Q. Now, I want to call your attention to the Franquist patent, 1,153,902. Have you read that patent? A. Yes.

Q. Will you describe briefly the construction of that piston so we will have it again before the Court? A. That is a piston with vertical slots in grooves running from the open end to a horizontal slot. These vertical slots being four in number, so dividing the piston that there is a pad on each side of the piston perpendicular to the wrist pin bosses. There is also a relief on the portion of the piston between these vertical slots which support the wrist pin boss, this relief being around the end of the wrist pin.

Q. Now, the specifications states, page 2, lines 11, et seq.: "The sections 14-14 which carry the piston pin bosses, remain integrally connected to the piston head 2 and are relieved from a point on the level with the rear-most piston ring to a point below the piston pin bosses, approximately .005 of an inch on the side, to insure that upon the expansion of the piston the portion of the sleeve which carries the bosses will be prevented from sticking to the cylinder walls, and causing either the motor to stop, or the breakage of the parts." Will you refer to Fig. 1 and tell me, if you can, the extent of the relief downward? A. On Fig. 1 I should say from the drawing that that relief ran from the top of the skirt below the ring land to the bottom of the skirt.

Q. In what way does such a relief compare with oval grinding with the short axis parallel to the wrist pin bosses? A. The relief would be the same, the effect of the relief would be the same as in the Franquist piston where oval grinding is shown.

Q. Now, there is a slot, there is a definite slot 17, on each side of the piston in that construction. The patent specification says, page 2, line 6, et seq.: "Circumferential slots 17-17 are cut in the outer surface of the sleeve in the sections 15-15 respectively, which slots extend to and join the longitudinal slot of 13, separating the longitudinal sections 15 from the head of the piston." Is it your understanding from that description that it is necessary that the horizontal slot be located in the ring groove at the bottom of a ring groove?

Mr. Richey: Objected to as leading.

The Master: He may answer.

A. Not from the specification, I should say.

Q. Well, the horizontal slot as shown in Figs. 1 and 2 seems to be located at the bottom of the ring groove; is that right? A. That is right.

Q. Now, I believe you heard Dr. Jeffries testify that that would cause transmission of heat, ready transmission of heat, and would not effect much isolation between the head and the skirt. What is your opinion on that?

A. Well, as I have already testified, the rings conduct the majority of the heat from the head to the skirt, and if there was a ring in this groove, that would help to conduct the heat to the cylinder wall. I mis-spoke myself first. I didn't mean conduct the heat from the head to the skirt, but from the head to the cylinder. And if there was a ring in this groove, it would help to conduct the heat to the cylinder wall rather than to pass it onto the skirt. Also I should say the ring there would help to insulate the head from the skirt.

Q. Now, the Mooers patent 1,402,309, specifically states, page 2, line 30, et seq: "It will be understood that this relationship might be that of a poor mechanical fit or joint which would be a poor conductor of heat, as compared with the metal of the head 2 and connectors 3, so that such heat as did pass from the head 2 to the skirt 1 would do so principally by way of the connectors 3, rather than from the head to the upper end of the skirt 1 directly." What have you to say now with reference to the slot 17 of the Franquist construction, as compared with the quotation from the Mooers patent? A. I should say the slot 17 had much the same effect as the slot in the Mooers patent.

Q. Now, in the Mooers patent, however, there are narrow connectors 3 distributed around. Do you find such narrow connectors in the, for instance, Plaintiffs' Exhibit 1? A. Not identical, not the same type connectors.

Q. How do those connectors compare with the connectors of the Franquist patent? A. These connectors, I should say, would amount to about the same thing as in the Franquist patent.

The Master: You are speaking now of Exhibit

1?

The Witness: Yes.

Q. You mean of Exhibit 1. The connectors of Exhibit 1 are about the same as in the Franquist patent; is that right? A. Yes.

Q. And they each extend about 90 degrees? A. Each extend 90 degrees, total about 180.

Q. You don't find any connectors as wide as that in the Mooers patent? A. No, sir.

Q. Neither do you find them in Exhibit 1, do you? A. No.

Q. Now, the Franquist patent also describes these pads 17-17 which are connected with the part carrying the wrist pin bosses by elements 12. What is the nature of those elements? A. Those elements are slots or grooves such that when the piston expands they are supposed to flex in this patent.

Q. He, however, says, "One embodiment of such a construction is shown in my drawings, and will now be described." What do you think from that, that only the specific constructions have to be used, the specific slots? A. No, I should judge he intends that there might be more than one construction of those, or different constructions of those slots; he only describes one, however.

Q. What could be done to make the structure more flexible, for instance, as shown in the model Defendants' Exhibit 3-Q, which has identically the same proportions as shown in the patent (Franquist)?

Mr. Richey: Wait a minute, are you testifying on that or does the record show that?

Mr. Bruninga: The record shows that.

Mr. Richey: All right, beg pardon.

A. The walls of this piston and these slots may be made thinner, the length of the slot could be increased, which would increase the lever arm and make the slots more flexible. Those are two of the things that I could see off-hand could be done.

Q. And what would happen if you cut all the way through a slot on one side of the wrist pin, one on either side? A. That would make that side of the skirt adjacent to this cut very flexible.

Q. In what way would such a construction distinguish from the Hartog patent 1,842,022?

Mr. Richey: Object to that as immaterial.

The Master: Same ruling.

A. The function of the Franquist piston when slotted as you suggest would be similar to that obtained by the construction shown in this Hartog patent.

Q. With reference to the connectors, then, the connectors from the head to the skirt, comparing Exhibit

1 with the Franquist patent and with the Mooers patent in suit, state which exhibit more closely resembles in that respect. A. I should say that Exhibit 1 was practically the same as that shown in the Franquist patent, and quite different from those shown in the Mooers patent 1,402,309; the Mooers patent being distributed all around the head, between the head and the skirt, while in the Franquist and the Exhibit 1, they are confined to the two sides over the wrist pin boss.

Q. How about the reliefs in Exhibit 1 and in Franquist? A. Very much the same as far as operation is concerned. In Exhibit 1 they are cast in, and very deep, while in the Franquist patent they are apparently machined in and are only .005" in depth, but the operation of the two reliefs would be approximately the same.

Q. Will you briefly describe or compare an ordinary double-acting steam engine piston with a cross-head, a cross-head piston and an ordinary trunk piston?

A. In a double-acting steam engine we have the piston head so arranged that the power of steam can be applied to either side of the piston and push and pull the piston head. This piston head is then connected to a cross-head, which runs in guides, and from there to the crankshaft by the usual connecting rod. This cross-head is entirely separate from the piston and is connected to it by a suitably long piston rod. In the so-called cross-head type piston the cross-head is much nearer the head of the piston, that is the cross-head portion of the piston is much nearer the head than in the steam engine, but the same designation can apply because the force of the piston bearing on the cylinder wall is entirely from the piston head, except by inside connectors, which, when you are referring to the steam engine, would be the piston rod. In the trunk piston, however, as used in an automobile motor, the skirt of the piston and the head of the piston are one piece, there being no separation between the head and the skirt. I think that is the essential difference in the three types.

Q. I call your attention to the Roots British patent 19,559 of 1890. Have you read that and do you understand that structure?

Mr. Richey: I object to it as not being cited in the answer.

The Master: Same ruling as the others.

A. Yes.

Q. Will you describe the Fig. 2 construction? A. Fig. 3 is the cross-head type of piston and connecting rod construction, A representing the head, and B representing the cross-head. The portion representing the pointing to the arrows, E points to the point of support between the cross-head and the cylinder wall.

Q. What is the part B in Fig. 3? A. That is the connecting rod, what might be called a single ended rod, fastened into the cross-head E by a pin between two bearings.

Q. In other words, there is a pin between two separated parts, is that right? A. Two separated bearings.

Q. What is that sort of connection called in practice, has it any name? A. That is the locomotive type of rod.

Q. That is the locomotive type of rod in which you have the connecting rod or the pitman between the two bearing walls, is that right? A. That is right.

Q. What did I understand you to say that general piston structure represents? A. That is a cross-head type of construction.

Q. I will now call your attention to the Ebbs patent 700,309. Have you read that patent? A. Yes, sir.

Q. What type of construction does that represent? A. That might be called the cross-head piston, in that the skirt is separated from the head by circumferential slot, and the piston head is joined to the cross-head by an internal strut.

Q. I want to call your attention to the statement in the specification, page 1, line 31, et seq.: "Then, again, the large area connecting the rearward and forward piston parts, causes the distribution of very considerable heat from the rear to the forepart of the piston, thus considerably increasing the amount of friction generated in the straight guiding of the four piston parts." What does that convey to your mind as one skilled in the art? A. Well, it refers, I judge, to the conduction of the heat from the head to the piston skirt.

Q. Now, can you briefly describe the construction of that patent? A. This patent is so arranged that there is a comparatively small amount of heat conducted from the head to the piston skirt or cross-head because of the circumferential slot shown between the head and the piston.

Q. Now, what is the construction, how is that attained, describe it by using the reference numerals, a, b,

and so forth? A. The portion d joins the cross-head with the head, and is screwed into the head, as shown by the threaded portion in the upper part of the cut. This portion d joins the cross-head c which carries the wrist pin and also carries the skirt f. This particular construction evidently is used as a forked rod, with the bearing outside of the web shown at c.

Q. And what practice does that represent? A. That is what is called the marine type of rod.

Q. That is the marine type of rod in which you have a forked connecting rod taking over a bearing, a small bearing, is that right? A. No.

Q. Now, suppose you wanted to use a locomotive type construction as illustrated in Fig. 3 of the Roots British patent, what would you do then with that structure in order to secure that kind of connection? A. You would have to separate or make a portion of the part shown at c so that the rod could extend in to this, and the bearing kept on the outside of the rod rather than in the middle.

Q. Now, keep these patents before you and examine the Spillman & Mooers patent 1,092,870. Have you read that patent? A. Yes, sir.

Q. What does that piston represent, a trunk piston or a cross-head type piston? A. A cross-head, I should say, essentially a cross-head type.

Q. How is the connecting rod attached to that piston? A. The connecting rod is attached to what is called the locomotive type where the bearings are outside of the rod, the bottom of the skirt forming the support—or the ribs to the head of the bearing forming the support.

Q. As distinguished from the Ebbs type, which is the marine type; is that right? A. That is right.

Q. Now, employing the Spillman & Mooers patent, or the marine type in the Ebbs patent structure, would you get any essentially different construction?

Mr. Richey: Objected to as leading.

A. Not so far as the operation of the piston was concerned.

Q. In other words, the distinction between those two structures, as I understand them, is that the connecting-rod is between two bosses rather than a single boss between two forks on the connecting-rod?

Mr. Richey: Same objection.

The Master: Same ruling.

A. That is all the difference.

Q. Now, the parts *f-f*, what do they form together in the Ebbs patent? A. They form the slipper portion of the cross-head which bears against the cylinder wall.

Q. What name can that have, if you use the same terminology as in the trunk piston? A. The skirt.

Q. Now, I notice right below Fig. 2 there are two spaces shown. What do those represent? A. They represent slots which divide the circumference of this piston into two parts or slippers.

Q. Now, I notice that in the Spillman & Mooers patent structure the head is connected with the skirt at the bottom, and in the Ebbs patent the head is connected with the skirt about the middle. What is the difference? A. Well, the difference, fundamentally, I would say would be that perhaps the point of support in the Spillman & Mooers being a little farther removed from the piston head, would make the temperature of the lower end of the skirt a little lower than in the Ebbs. In the Ebbs the connection is about half way between the top and the bottom of the skirt.

Q. The Spillman & Mooers patent 1,092,870, reads as follows, page 1, line 71: "In the construction illustrated in the drawings, the web is separated from the surrounding walls of the head and guide sections by a comparatively wide space, and the upper end of this connecting web joins the back of the head section, while its lower end joins the guide-section near its lower end or at a point remote from the non-conducting gap 6, whereby the amount of heat transmitted through the web from the head to the guide section is reduced to a negligible degree, not only on account of the remoteness of the lower end of the web from the gap, but because the web is constantly cooled by the large volume of oil in the crank case." When the expression is used "near its lower end or at a point remote from the non-conducting gap 6," do you understand by that that the connection must be made just exactly as shown in the drawings? A. No, I shouldn't say just as shown in the drawings, but somewhere between the bottom of the skirt and the center of the wrist pin.

Q. Well, consider that Spillman & Mooers patent, for instance, Fig. 2, and keep on raising the connection, and tell the court what would happen as far as perhaps a compromise is concerned, between the two? A. If you will raise the point of connection between the skirt and

the supporting member, you will gradually get the point of support up to say the center of the wrist pin boss, where you have equal distribution of heat throughout the whole of the skirt section; and to my mind it would be a very good construction.

Q. Well, suppose you keep going up still farther?

Mr. Bichey: Oh, I think this is immaterial. I think you have to consider what the man shows in the patent, and what is in the prior art; not as this witness wants to change it around.

The Master: He may answer; same ruling. It will save time, I think.

A. Well, if you went up, continued to go up, of course you would get unequal distribution of the heat and the top of the skirt would be the hottest.

Q. What have you to say about the Mooers patent 1,402,309 in that connection? A. That is what happens in the Mooers patent.

Q. Do you get as efficient transmission of heat in the Mooers patent structure as you do in the Spillman & Mooers patent structure? A. I should not think so, no.

Q. I call your attention to the Spillman patent 1,229,540. What is the difference between that patent construction and that of the Spillman & Mooers patent 1,092,870? A. The wrist pin bosses in the Spillman & Mooers patent are supported by the skirt and independent of the vertical struts or webs which support the skirt, while in the Spillman & Mooers the wrist pin bosses are supported by those webs which support the skirt from the head.

Q. Now, the connection is again to the bottom of the skirt, isn't that right? A. That is right.

Q. Do you know whether the purpose is the same or different as in the Spillman & Mooers? A. The same.

Q. Well, suppose you keep on running that connection up the side of the skirt, what effect does that have upon a compromise, efficiency, and anything else? A. You would get the same effect as you did in the Spillman & Mooers, in that you get a more equal distribution of heat until you get up, as you reach the center, as you went by the center to the top of the skirt, the top of the skirt would get hotter as compared to the bottom.

Q. Do you know whether the Spillman & Mooers patent structure has ever gone into commercial use? A. I understand it did.

Mr. Richey: I object to what he understands as incompetent.

Q. Well, do you know? A. I know it did, yes.

Q. What company used it? A. A motor concern at Tonawanda,—Sterling Motors.

Q. Sterling Motors Company. Do you know the Herschil & Spillman Company? A. Yes; Herschil was the one.

Q. What about Herschil & Spillman? A. They used the Spillman & Mooers piston.

Q. Now, that Spillman & Mooers patent structure seems to have originated in 1913, the application being filed July 18, 1913. Were aluminum pistons in general use at that time? A. No, sir.

Q. Was there any necessity of splitting that skirt of the Spillman & Mooers patent structure at that time? A. Not if made of cast iron.

Q. Not if made out of cast iron. And did the separation of the skirt from the head have any effect upon permitting temperatures to be run higher than a straight trunk piston? A. Yes; I would say that the piston would lend itself to operate with comparatively small clearance between the cylinder and the piston.

Q. Now, let's take the situation when aluminum pistons came into use, and you as an engineer had been called upon to design that piston of aluminum alloy for an automobile, and with the high co-efficient of expansion of aluminum, what would you have done in 1915?

Mr. Richey: I object to that as too highly speculative to be material.

The Master: This man is here as an expert. He may answer the question. You may cross-examine him about it.

A. It is evident to me that the thing to do would be to slot the piston.

Q. Split the skirt; is that right? A. That is right.

Q. Did you have any precedent for that? A. That is what we did in the Exhibit B, we split the skirt from the bottom up as far as we could. Of course the logical thing to do in this piston would be to split the skirt all the way from the bottom to the horizontal slot.

The Master: Which one are you talking about now?

The Witness: The one, in the Spillman & Mooers patent 1,092,870.

Q. In addition to the split in piston rings, were you familiar in 1915 with railroad rails? A. Yes.

Q. And how were those rails laid? A. They were laid with expansion joints between them, which corresponds to a slot.

Q. Would that have been necessary if the temperature of the particular country would not have varied more than ten degrees? A. I should say not.

Q. But with winter and summer, with the extremes of temperature, it was necessary? A. Yes.

Q. And that provided a gap between the rails? A. Yes, so they could expand and contract.

Q. Do you know of any other instances where slots are placed between two parts in order to compensate for increase in temperature and expansion of materials? A. Well, you take bridge construction, for instance, one end of a bridge is free to expand and contract, some times when the other is fastened permanently. They often times put large rollers under one end of the bridge so it can expand and contract, a common, ordinary construction. Piston rings are made that way. That was a common, ordinary construction as used in the automobile industry, slotting the rings so they can expand and contract.

Q. Well, if you wanted to split the piston of the Spillman & Mooers patent structure, where would you split it? A. I would split it on a line, on one side of the skirt, on a line perpendicular to the center line of the wrist pin.

Q. And where would you have split it in 1915, in the early part of 1915, assuming that you wanted to make it out of aluminum?

Mr. Richey: I object to this as immaterial. There is a host of authorities to the effect it is not proper to go back and use hindsight; an expert's opinion of that kind to invalidate patents. That is all he is doing.

The Master: The same ruling.

A. The same applies as I have described.

Q. Between the wrist pin bosses? A. That is right.

Mr. Brunning: Is the translation of the Chenard & Walker patent satisfactory?

Mr. McCoy: Oh, we think so, in general. I haven't checked it up carefully. I don't think there will be any differences.

(Short recess taken.)

Q. I hand you a copy, photostatic copy, of French patent 468,595, to Chenard & Walcker, together with a translation. Have you read a translation of that patent?

A. Yes.

Q. Will you briefly describe that particular piston?

A. This is a trunk type piston with the skirt separated from the head by the horizontal slot A, B, and ribs running from the head and the wrist pin boss, supporting the skirt, through the wrist pin boss.

Q. In what way does that particular structure shown in the Chenard & Walcker patent distinguish from the Ray Day piston, Plaintiffs' Exhibit 8? A. With the exception of the vertical slot on one face of the piston, I would say this piston was practically described in the Chenard & Walcker patent.

Q. Can you see any difference between them at all?

A. I don't, with the exception of the slot.

Q. In other words, slotting the Chenard & Walcker piston, would you have any difference between such a structure and the Ray Day piston, Plaintiffs' Exhibit 8?

A. In operation, no.

Q. Would the structure be any different at all? A. The structure is somewhat different, due to internal ribbing.

Q. You mean the internal ribbing on the inside? A. Yes. And also the relief is shown on the Ray Day piston which is not shown on the Chenard & Walcker.

Q. But again, with reference to that relief, what do you understand by the following statement in the patent: "We know that the pistons of this type make the cylinders oval and, in order to avoid this objection, we have given them a cross-section quite complex which we obtain on the copying lathe, so that through expansion they will be exactly applied against the wall of the cylinder." A. That said they ground the piston oval so that there would be a relief around the wrist pin bosses similar to that, in effect, as shown in the Ray Day piston.

Q. Does the patent limit the structure to one in which the ribs *d* are exactly as shown? A. No; as I understand,—as I remember the patent, it said that those ribs could be placed anywhere with respect to the side walls of the piston and the head.

Q. Part of the specification reads as follows, on the second page of the translation: "In the mode of construction shown, the partition *d* which connects the two parts *a* and *b* of the piston, are parallel, but it is evident

that they might constitute a cross-piece or be disposed in any other way. We can even replace these rectilinear partitions by a single circular partition, if desired, but always having a cross-section as slight as possible in order to reduce to a minimum the transmission of the heat from the part *a* to the part *b*." Does that read as if the construction is identical with that illustrated? A. No; it gives a very broad disposition of those ribs.

Q. Neither the Chenard & Walcker nor the Spillman & Mooers patent states that the part *d* of Chenard & Walcker or the parts 8 of Spillman & Mooers are flexible; neither of them state that, do they? A. No, sir.

Q. But with the parts of the dimensions as shown in the particular patent drawing, if the skirt of Chenard & Walcker or the skirt of the Spillman & Mooers patent structure were split between the wrist pin bosses, what have you to say as to rigidity or flexibility? A. I should say the skirt would be very flexible in either one of them, when the skirt was split with a slot running from the bottom of the skirt to the horizontal slot.

Q. I call your attention to Exhibit 3-P. Dr. Jeffries said that is a fair representation of the Spillman & Mooers patent structure; that is, except for the splitting of the skirt. Do you agree or disagree with him? A. I would say that is a very flexible piston, yes.

Q. That splitting of the skirt is, however, between the wrist pin bosses? A. That skirt is split between the wrist pin bosses, yes.

Q. What do you find as to its flexibility? A. Very flexible.

Q. I notice that there is a wrist pin in that piston. Does that add or detract anything from the stiffness?

A. I should say it detracted from the flexibility very materially, because a wrist pin is tight in here, tighter than it would be in the actual operation of the engine.

Q. If you took the piston structure as shown in the Spillman & Mooers patent and as shown in the Chenard & Walcker patent and made a piston of that kind and split it between the wrist pin bosses and put it in a cylinder, could you stop it from contracting as the heating went on? A. Not when she warmed up.

Q. The slot contracts; is that right? A. That is right.

Q. And the piston as a whole expands? A. That is right.

Q. I want to call your attention to the White patent 1,195,936.

Mr. Richey: That is not in the answer either. I object to it as not set up in the answer.

The Master: Same ruling.

Q. Have you read that patent? A. Yes.

Q. What does that generally represent? A. A cross-head type of piston.

Q. Well, how about a slipper piston? A. Slipper.

Q. Is it also called a slipper piston? A. Yes.

Q. In what way does a slipper piston distinguish from the trunk piston? A. The slipper piston has portions on the skirt at the ends of the wrist pin bosses cut away so that only those portions of the skirt perpendicular to the wrist pin bosses are in contact with the cylinder.

Q. Where is that head on that piston; what indicates the head? A. No. 4.

Q. And what number represents the slippers? A. No. 6.

Q. Is there any peculiar connection between the pitman and the piston, and particularly the construction of the piston as far as relation of slippers and head is concerned? A. No.

Q. I call your attention to Ricardo patent 1,294,833. Have you read that patent? A. Yes.

Q. What type piston does that represent? A. That is the slipper type piston, the cross-head type.

Q. Do you know who Ricardo is? A. Yes; I understand he is quite a noted British engineer.

Q. He has written in magazines a good deal, I think? A. Yes.

Q. And he is a text book writer, too? A. Yes, quite a noted engineer.

Q. How is he regarded in the automotive industry? A. Very well, I think.

Q. Now, if you find, or if you would have found in 1918 that such a piston made of aluminum alloy would seize in the cylinder, what expedient would you have resorted to? A. Slotted the skirt opposite the wrist pin or perpendicular to the wrist pin between the two webs.

Q. In 1918 you had already split a skirt, as I understand, of the structure that the Franklin used in 1916; isn't that right? A. Yes.

Q. If you would have had a slipper piston in 1915 or at the time that you started to split that skirt, would

you have proceeded differently? A. No; I should say the same procedure would be followed.

Q. And what happens if you split the slippers vertically of the Ricardo piston structure and you put it in a cylinder with a small clearance and the temperature goes up? A. The webs marked C would flex and the piston would have been made flexible.

Q. Could you stop those webs from flexing with the ordinary construction as used in slipper pistons? A. Not if made with such amount of metal as shown in the drawing in the webs.

Q. In what way, if any, does the Ricardo piston structure differentiate from the Jardine patent structure of the Jardine patent in suit? A. I would say essentially the difference was the slot in the slippers, in each slipper.

Q. Well, you do have some fancy ribs 27 and 27a, don't you? A. Yes.

Q. In Jardine? A. I don't see how they would affect the operation of the piston.

Q. And you also have a fancy curve from the ring flange down to the skirt, haven't you, that Mr. Ricardo hasn't got? A. You mean in the slot?

Q. Oh, I mean this fancy curved web from 23 down to the main web. A. Yes; but I don't see how that would affect the operation of the piston.

Q. I don't either. I am asking you. Now, Mr. Ricardo has overhanging slippers, as shown, for instance, in Fig. 3, which overhang. Why do you think those are overhanging that way,—for any useful purpose at all? A. Well, it gives them a wider slipper bearing with that arrangement of webs.

Q. But it does prevent him from getting out a mold piece, doesn't it? A. Yes.

Q. And in 1915, or even when you were a boy, what would you have done if you had found such a condition? A. Cut them off if I wanted to get the mold out.

Q. Do you think you would have displayed an enormous amount of ingenuity by doing that?

Mr. Richey: I object to that as immaterial.

Mr. Bruninga: I know; but some of these things in these patents are simply absurd.

Q. Now, I call your attention to the Anderson patent 1,283,021. Have you read that patent? A. I don't think I have.

Q. Well, can you read drawings? A. Yes.

The Master: Well, it is after four o'clock. He can read that patent to-night.

(Adjournment to the following day, at 9:30 a.m.)

(Thereupon, at 9:30 A. M. Tuesday, January 31, 1933, the hearing was resumed.)

Q. Did you read that Anderson patent last night?

A. Yes.

Q. Now, compare these slippers of the Anderson patent with those of the Ricardo patent as far as extensions beyond the webs are concerned; and state what you find? A. The extensions are cut off on the Anderson patent at compared with the Ricardo patent, the extensions of the slipper beyond the web are cut off.

Q. What do you find in the corner between the little slipper stub and the web? A. There is a fillet in the corner there.

Q. What is that fillet used for? A. It would not be good practice to make a sharp corner there, in the first place, and probably that is put there so that they can draw that out of the sand.

Q. How long have fillets been known to your knowledge? A. Ever since I have had any knowledge of engineering.

Q. Wasn't that about the first thing that was taught you when you had instructions in pattern making and molding? A. Yes.

Q. Now, what are the parts 11, Fig. 1 of the Anderson patent? A. They are ribs from the head to the wrist pin bosses.

Q. Now, what are the parts 13 of the Anderson patent, Fig. 2? A. Those are webs running parallel to the wrist pin boss, from the head to the wrist pin.

Q. How do the webs 13 of the Anderson patent compare with the webs 9 in Fig. 3 of the Jardine patent? A. I should say they were the same general design.

Q. What is the web 12 of the Anderson patent? A. It is a web across the head of the Anderson patent, parallel to the wrist pin boss.

Q. How does that web 12 compare to webs indicated by the 8 in Fig. 3 of the Jardine patent? A. They seem to go across the head in the Jardine patent much the same as the web 12 in the Anderson patent.

Q. In the Anderson patent, however, the slippers are not severed from the head, is that right? A. That is right.

Q. Illustrating the relation between the locomotive and the marine connections, I want to call your attention to German patent 176,988.

Mr. Richey: Is that in the answer?

Mr. Bruninga: No.

Mr. Richey: I object to it as not being set up in the answer.

The Master: Same ruling.

Mr. Bruninga: Mr. Richey, practically all of these, I don't think without any exception are in the answer in the Simmons case.

Mr. Richey: Then you have known about them for a long time before the answers were filed in this case and you haven't given us any notice of them?

Mr. Bruninga: Oh, sure. Sure; I had no idea you were going to use an ordinary slipper piston as infringing any of the patents in suit, or an ordinary T-slot as infringing all of the patents in suit, and even the straight slot with an L, as infringing all of the patents in suit. I thought it would be limited to what the patents disclosed and claimed, together with the specifications, read together, instead of covering things that have been in use and in patents and publications for 20 years.

Mr. Richey: I move that statement be stricken out as argumentative.

Mr. Bruninga: I am perfectly willing to have both of them stricken.

Mr. Richey: No, I want mine left in.

The Master: Leave both of them in.

Mr. Richey: May I reply to this statement he made?

The Master: Yes.

Mr. Richey: Counsel has known for some time of the attitude of the plaintiff about the patents in suit; he has known about the suits here against the Simmons Company and the Lawrence-Ohio Company. His clients have been advised of their infringing actions whenever they have come to the notice of the plaintiffs. Although he has known for at least two weeks that the plaintiff charged that the specific devices now charged to infringe were charged to infringe, these devices were injected into the case by defendants' counsel, he has not notified us of his intention to rely upon anything not set

up in the answer. We at the present time deny that the subject matter of any of the patents in suit is old, and at the proper time we will reply to that challenge specifically. All I care to leave in there is the fact that you have known of these things a long time and haven't told us anything about them. That is all I care. You may leave the balance of it out if you want to.

(Previous question read.)

Q. Can you read the drawings of that German patent structure? A. Yes, sir.

Q. Can you read it and even without any description tell what the structure is? A. Yes.

Q. Now, compare the piston construction in the German patent 176,988 with that of the White patent 1,195,936 as far as connections between the cross-head or the piston and the connecting rods are concerned?

Mr. Richey: Objected to as immaterial.

The Master: Same ruling.

Mr. Richey: There is no issue here between these patents. The issues are validity and infringement.

A. The German patent shows the type of cross-head connection for a marine type of connecting rod, where the connecting portion of the rod is split and goes each side of the wrist pin bearing in the cross-head. In the White patent the so-called locomotive type of connecting rod is shown, where the connecting rod goes beyond the two bearings and in the slipper or cross-head constructions.

Q. Now I notice there is a peculiar construction in the White patent with, first, the straight pin connection and then a roller connection; has that anything to do with the essential features of the piston construction as a piston construction?

Mr. Richey: Same objection; further as leading.

The Master: Same ruling.

A. No, sir.

Q. I call your attention to French patent to Serex, 434,147, and patent in addition to that patent, 16,362, also to Serex, together with translations which I have attached. Have you read the patents and the translations?

Mr. Brunings: I may say in this connection I gave Mr. McCoy a copy of those patents and the translations yesterday. Those were recently discovered.

Mr. Richey: I make the same objection, that they have not been set up in the answer.

The Master: Same ruling.

A. I have read them.

Q. Will you take first the original patent 434,147, and briefly explain what you deem pertinent to this case?

A. This is a sleeve valve or piston valve, in which a piston slides inside of the cylinder or valve casing. This valve as working by the ports seals the ports against the gases in the cylinder. The pertinent part of this valve is the section shown at 1, which is a T-slot portion of the sleeve and serves to expand against the cylinder wall to keep the valve tight across the ports.

Q. What does the Fig. 5 show? A. Fig. 5 is a section through this T-slot, this being the slot shown at n and o, is the free portion of the piston, showing the clearance enlarged.

Q. What does the inside annular show in Fig. 5, and what does the section outside show? A. The section outside shows the portion of the valve, and inside shows the portion of the sleeve, if it wasn't slotted, I should say.

Q. Well, can you tell whether they are pulled out or what? A. They are expanded out so as to have a springing action from this section to that.

Q. Now, continue with the next patent. A. This is much the same idea except that the T-slot is put at both the bottom and the top of the valve to hold the valve against the side of the cylinder wall.

Q. Now, I notice that in Fig. 6 the same reference letters n and o are used as in the original patent. Now, can you tell me what bearing Fig. 6 has upon the lower part of the structure, that is the piston d, if any? A. Well, it illustrates the operation of the T-slot in the lower part, being the same as the operation of the T-slot in the upper part.

Q. In other words, again, the spread-out part in Fig. 5, does that have any bearing on the lower part of the structure d? A. Yes, it shows the same action as this part, being sprung out from a circle, the inner circle, so that there is a pressure set up between the section "o" and the cylinder wall which tends to keep the valve

tight against the seat of the cylinder opposite the T-section.

Q. Well, can you illustrate that a little better, using piston Exhibit CCC? I don't want you to even say that they bear any resemblance, but as illustrating what you said was the T-slot at the lower end of the piston, in connection with Figs. 2 and 5 of the patent of addition, 16,362? A. In piston Exhibit CCC, this portion marked as "o" would be represented by the portion of the piston surface bearing the slot, the slot being represented by the space between these two portions marked as "o." If this was bent out or sprung out so that it moves from this point to there (indicating) then you would have a pressure against any cylinder wall, which would press out, and you would have to push it in, causing a springing action on these surfaces.

Q. What is the net result of that T-slot arrangement in the French patent, whether at the top of the piston valve "d" or at the bottom of the piston valve "d"? A. The net result is that it holds the piston against the cylinder walls, and therefore seals the piston against the gases passing up the walls.

Q. Now that piston "d" in neither case is the power piston, is it? A. No, sir.

Q. It is a piston valve, isn't it? A. That is right.

Q. But from the title, it says, "Slide valve with alternating movement for valveless engine," and what kind of an engine do you understand that valve to be for? A. I should say combustion engines, automotive engines.

Q. And can you tell me how close the valve, the piston valve, is to the cylinder of the engine? A. It is a common sliding piston.

Q. I mean is it alongside of it or far away from it? A. Right beside it.

Q. Will the valve barrel get hot, then? A. Yes.

Q. And is there any utility in that connection of providing a T-slot? A. Yes, it allows for expansion and contraction of the piston in the cylinder and of the valve.

Q. In what way does such connection compare, if at all, in providing a T-slot in a power piston of an engine? A. I should say the connection was very similar to the power piston of an engine as far as the fit between the valve and the cylinder or its casing is concerned.

Q. In connection with the Schmiedeknecht patent, I want to call your attention to the Fairy British patent 12,772 of 1914. Have you read that patent? A. Yes, sir.

Q. Just briefly describe the construction of that piston. A. This is what might be called a cross-head or an hour-glass type of piston, in which the wrist pin supporting member is made of a separate piece riveted into the piston proper, the inside member being the cross-head type and carrying the wrist pin.

Q. In what way do the webs 6 in Fig. 3 of the Fairy patent compare with the webs 21 of the Schmiedeknecht patent in Fig. 4? A. I should say that the web was essentially the same in the Fairy patent as in the Schmiedeknecht, that is, web 6 functions the same as the web 21 in the Schmiedeknecht patent.

Q. In other words in both cases they go across from skirt wall to skirt wall? A. That is right.

Q. But how about the wrist pin bosses 9 in Fig. 3 of the Fairy patent, how are they mounted? A. They are mounted on the web at one end only; they are not carried out to the skirt of the piston as in Schmiedeknecht.

Q. In other words, how does the mounting of the web in the Fairy patent compare with the mounting of the web on piston Exhibit 1? A. Same general idea in the patent as in the piston Exhibit 1.

Q. Why do you say that? A. Because the wrist pin boss, as shown in the patent, is mounted in the web at one end of the boss; and in the Exhibit 1 the wrist pin boss is mounted directly in the web, more nearly central to the boss, but the construction is practically the same in the two cases.

Q. Now, in what way is the wrist pin boss mounted in the Schmiedeknecht patent? A. The wrist pin boss is mounted at one end of the web extending across the skirt, and, at the other end in the skirt of the piston directly.

Q. Are mountings, in which boss is mounted in the center of a web, and the construction in which a web is mounted or supported between its ends, the same? A. I could not say they were the same, no.

Q. In other words, compare the three, Plaintiffs' Exhibit 1, the Fairy patent and the Schmiedeknecht patent as to the mounting of this wrist pin boss; which are the most similar of the three? A. Plaintiffs' Exhibit 1 compares very much more nearly to the one shown in the Fairy patent than the one shown in the Schmiedeknecht patent.

Q. Have you read the Pugh British patent 17,256, of 1907? A. Yes.

Mr. Bruninga: Mr. Richey, that is also cited in the answer and cited by the Patent Office.

Mr. Richey: Cited against what patent in the answer?

Mr. Bruninga: The Schmiedeknecht patent.

Mr. Richey: And your inquiry is limited to that, to the Schmiedeknecht patent?

Mr. Bruninga: As to this construction; I wouldn't say so.

Mr. Richey: If the question is not limited to the Schmiedeknecht patent I object to it as not pleaded.

The Master: Well, when the question comes I will pass on it.

Mr. Richey: I have to object or my right is waived, that is the rule.

The Master: Very well.

Mr. Richey: Certain of these patents in the answer are cited against certain of the patents in suit. May it be understood, without my repeating the objections, if either counsel or the witness undertake to apply them to any other patent than those against which they are cited, it will be understood I object to that as not being properly pleaded?

Mr. Bruninga: Yes.

Mr. Richey: May it also be understood in case you produce any further patents or items that are not set up in the answer, that I object to them on the ground they are not set up in the answer, without my repeating the objection?

Mr. Bruninga: Yes, the record will show that anyway.

Q. Now, you have read that patent, have you? A. Yes.

Q. Now, the specification contains numerous figures. I wish you would limit your explanation to Figs. 3 and 4, the descriptive matter I believe is found at the bottom of page 5 of the specification. Will you just briefly explain that construction, and particularly the mounting of the wrist pin bearings, I will call them? A. This piston construction is essentially a built-up steel piston. Regarding the wrist pin bearing, it is shown at one end of the wrist pin as mounted from a web suspended, sprung from the head of the piston, and the other end of the wrist pin is mounted on the skirt wall.

Q. I want to call your particular attention to Fig. 4. You say suspended from the head. What does Fig. 4

show? A. Fig. 4 shows it is also sprung from the piston wall, that is, webs running to the piston wall support the wrist pin boss. Comparing this to the Schmiedeknecht patent, we seem to have the same construction in this piston, as far as the wrist pin boss supporting members are concerned, except that this support is sprung from the head as well as from the side walls of the piston.

Q. But you don't find holes punched in the side?

A. No.

Q. In the Pugh patent, do you? A. No.

Q. And I believe you said that was the practice, to bore holes in pistons?

Mr. Richey: Objected to as leading.

Mr. Bruninga: I am asking him if he said so.

Mr. Richey: If he said so, no need to repeat it.

Q. Did you say so? A. Yes.

Mr. Richey: I object to it as leading and immaterial.

The Master: The question has been answered; go ahead.

Q. What have you to say to the Fairy patent with reference to any holes? A. The Fairy patent has a relief around the end of the wrist pin in the skirt of the piston, much the same as the Schmiedeknecht.

Q. Well, both of these constructions of the Pugh and the Fairy patent are built up structures. Will you look at Figs. 1 and 2 of the Fairy patent and tell me in your opinion whether that could be cast in a single piece?

A. Yes, I think it could be cast in one piece, that is, the skirt, head, and cross-head section could be cast in one piece.

Q. Not the wrist pin, of course? A. No.

Q. What have you to say to that Pugh patent, Figs. 3 and 4, could that be cast in one? A. That could be cast in one piece as shown in those figures.

Q. Now, considering this Exhibit 1, and with the relief pushed in, why in your opinion do the wrist pin bosses extend outside of the relief, from a design standpoint? A. Well, it is good practice to design the wrist pin boss and have the support near the center of the boss to distribute the load, and also it is desirable of course to get the wrist pin bosses as far apart as possible, making the boss as long as can be.

Q. Now, in the design of any bearing, is any attention paid to the length of the bearing, compared to the

stresses that are encountered? A. Oh, yes, fundamentally, yes.

Q. Any rules of design on that? A. Well, it is desirable to keep the load on the bearing to within certain limits, and the bearing has to be proportioned in length and diameter to the load it carries.

Q. Would it be, then, the proper practice from a pure matter of design, where the relief is pushed in, to cut off that bearing on the outside so as to be even with the piston?

Mr. Richey: Objected to as leading.

A. I couldn't say the bearing would be long enough to bear the load under those conditions.

Q. Considering now the Mooers patent 1,402,309, in connection with the Franquist patent, what happens upon expansion of the piston under heat? I have particular reference now to the Franquist patent and comparing that with the Mooers patent, assuming, for instance, that the line of connectors 3 at right-angle to the wrist pin bosses, are omitted? A. The action of the Franquist patent under heat, as I understand it, is that the piston expands on a line parallel to the center line of the wrist pin, and that expansion tends to pull in the side of the piston perpendicular to this line. This can take place because of the fact that the skirt portions of the piston between the vertical slots are cut away from the head above the slipper side of the piston.

Q. Can you illustrate that in connection with piston 3-Q? A. This piston of course expands in all directions or diameters, but when it expands in the line parallel to the wrist pin, which it can do because of the relief on this side of the piston, it has a tendency to pull this side of the piston in, and this side of the piston in, indicating on the sample.

Q. Indicating the parts that are cut away from the head.

The Master: The thrust faces?

The Witness: The thrust faces, yes. Because of the fact that this slot makes this part of the piston flexible to a certain extent, and because of the fact that this slot, the horizontal slot above the slipper surfaces or thrust faces, cuts this portion of the piston from the head, so that as this expands out, these cave in and the whole piston becomes more or less elliptical in shape.

Q. Now, comparing that with the Mooers piston. A. If we get out these connectors on the side, in this view No. 2, shown as 3, because 3 refers to all the connectors, to this connector in view 1 and the one opposite, shown here and here.

Q. You were pointing to the central connector 3 in Fig. 1 and the two side connectors 3 in Fig. 2? A. That is right. You have a construction very similar to that obtained in the Franquist piston and an expansion along the center line of the wrist pin in this direction, in Fig. 1, tends to pull the side walls of the piston or the thrust faces of the piston in towards the center of the piston. Perhaps I can illustrate it better in this view. (Indicating Fig. 3). The expansion in this direction tends to pull these thrust faces and this side of the piston in towards the center and makes that elliptical. Of course this can happen in the Mooers because the head is cut away from the skirt, but the skirt is not made flexible by vertical slots, so that any distortion in this piston would simply have to distort the skirt as a shell and make the cylinder become oval in shape.

Q. Can you tell me whether that action which you have described, pulling those cylindrical portions of the thrust faces in, would be affected in any way by the presence of the connectors 3 on those thrust faces in the Mooers structure? A. I should say it would, yes.

Q. What way does that affect that pulling in? A. That would retard the pulling in at the top of the skirt, certainly, and might make it impossible to pull it in.

Q. Do you find any connectors between the piston head and the skirt on the thrust diameters of Exhibits 1, BBB, CCC and 3-J? A. Well, on Exhibit BBB we have the head cut away from the skirt on both the thrust faces, and this piston could expand and contract, as I have outlined, in the Franquist piston. I suppose the slot could be cut through in Exhibit 3-J.

Q. Yes, the slot is supposed to be cut through. A. And the head is cut away from the skirt on one side of that piston only, and therefore the condition would be slightly different, but the operation on the thrust side or the slotted side of the piston would be somewhat similar to that of the Franquist. In Exhibit CCC, we again have the head cut away from the skirt on both sides of the piston, and the operation, I should say, would be very similar to that of the Franquist. In Exhibit 1, here again we have the head cut away from the skirt on both thrust

faces of the piston, and I should say the operation might be very similar to that in the Franquist piston.

Q. Now, I notice in all of those four exhibits there is a slot only on one side, and limiting myself to Exhibits 1, BBB and CCC, the skirt is cut away by a circumferential slot from the head on the solid side. Will you describe any action as to that particular non-slotted side with reference to what you have said in the Franquist patent?

A. The non-slotted side?

Q. Yes, the non-slotted side. In other words, you have referred to the pushing out, the diametrical expansion of the head carrying the skirt with it? A. Yes, that is the same action we have in the Franquist patent, namely, that this piston expands parallel to the wrist pin, and being cut away from the head can become elliptical, smaller on the thrust side, on the thrust faces, than on the faces parallel to the wrist pin.

Q. And permits the diametrical expansion of piston Exhibit CCC on the line of the wrist pin bosses? A. The piston is relieved on that side at the top of the skirt so that expansion can take place.

Q. And you said it was relieved in the Franquist patent all the way down? A. Yes. Of course it is different in that respect, in that at the bottom of the skirt this piston shown in Exhibit CCC is not relieved at the bottom of the skirt.

Q. But the skirt is split in that particular construction? A. Yes, that compensates for it.

Q. Well, as far as the bottom part is concerned with that slit in it, in what way does the operation of Exhibit B distinguish from the operation of CCC, so far as the bottom of the skirt is concerned? A. They are both collapsible, both Exhibits B and CCC.

Q. Now, Dr. Jeffries I believe said that Franquist patent structure is stiff because the wrist pin is clamped in the piston. Am I right or wrong on that, Mr. Richey?

Mr. Richey: Yes.

Q. How is the wrist pin mounted in the piston of the Franquist patent 1,153,902; explain that to the Court. A. My idea is that this pin floats in the piston and is tight in the rod, that is, this portion of the rod clamps the pin, and these oil holes running down from below the lower ring tend to lubricate this bearing here and here (indicating) so that it can float in those bearings and be properly lubricated.

The Master: In the wrist pin bosses?

The Witness: Yes, in the wrist pin bosses of the side walls of the piston.

Q. Unless that wrist pin did float in those bosses, would it be necessary or would anybody even suggest the oil groove right to that bearing as indicated by the reference numeral 8? **A.** I cannot see any object of lubricating a tight joint.

Q. Now, in that respect how does the structure compare with the Gulick patent structure, for instance as shown in Fig. 2? **A.** Very similar, I should say.

Q. In the Gulick Fig. 2 you also have a boss underneath which might look like it received a screw, is that right? **A.** Yes.

Q. Now the patent specification states, at page 1, line 52, et seq., you can follow the drawings while I read the specification: "These bosses are provided with ribs 7, through which an oil groove or hole 8 is bored in order to supply the lubricating material to a crank pin 9, which is suitably fitted in journals provided and held in place therein by set screws 10. The pin 9 carries the connecting rod 11, the construction thus far described being typical of the ordinary hollow trunk piston." Now, when it states the crank pin 9 is suitably fitted in journals provided in the bosses, does that convey to your mind it is supposed to be tight? **A.** No, a journal must refer to a moving part. In this case there is an oscillatory or reciprocatory—not reciprocatory but oscillatory motion between the pin and the journals.

Q. When it says "fitted in journals provided in these bosses and held in place therein by set screws," what does that convey to your mind? **A.** This shaded portion here evidently is a journal fitted into this wrist pin boss, and this journal is held into the boss with that screw. Then the wrist pin goes inside the journal and floats inside it.

Q. Can you tell me whether or not it was the practice to bush bearings in pistons? **A.** Yes, when cast iron was used it was quite common, almost necessary to bush the bearings with bronze or brass.

Q. Now, I notice that the Gulick patent construction has the same general idea, that is, that the boss at the lower end of the wrist pin bosses is arranged to receive a set screw, isn't it? **A.** Yes.

Q. And these bearings are much larger than necessary, isn't that right? **A.** I should say they were.

Q. What is your idea as to what Gulick intended?
A. I should say the idea of putting a journal in those bosses and using these set screws shown here, or the bosses for the set screws shown, to hold that journal in the piston; then the wrist pin oscillates in the journal itself.

Q. Is it your idea any bosses would have been provided at the bottom of these wrist pin bosses unless set screws were to be used? A. I cannot see why there would be, as long as he has oil ducts from the outside of the piston surface to these journals.

Q. Is it your idea those bosses are put on there in order to provide a straight surface to take the drill? A. Why, no.

Q. Why do you say that? A. Why, you can drill that without having any bosses there, and it is done very often by jig drilling.

Q. Now, what kind of mountings were used in pistons in 1914, what kind of wrist pin mountings? A. Why, the wrist pins were mounted to float in the piston journals or to float in the upper end of the connecting rod, usually, however, I would say they clamped in the connecting rod and floated in the piston, in those days. Here is another thing I might point out, and that is these set screws which hold the journals are put in there so that this oil hole, when drilled down through the journal, will always be held in line with the oil holes drilled in the piston.

Q. You have reference to the Gulick patent? A. Yes.

Q. What do you say now as to the Franquist patent in that connection? A. The same thing would apply in this piston, that is, you have got to hold the journal in the piston so that this oil hole in the journal will line up with that in the piston.

Q. Now, with reference to the Spillman & Mooers patent, which is acknowledged in the Mooers patent, Spillman & Mooers 1,092,870, and having reference to the Mooers patent 1,402,309, I want in this connection to use the model Exhibit EEE for illustration. That structure practically has to be cast in a sand mold, doesn't it? A. As shown, yes.

Q. And that is due to the fact there is a space between the connectors and the skirt? A. That is right, cord space.

Q. And the connection from the head is made to the lower part of the skirt? A. Yes, sir.

Q. Is there any change in that connection as distinguished from the Mooers structure? What I want to have you point out is any possible result of Spillman & Mooers to Mooers, and any compromise which would have to be made? A. Why, it is perfectly evident to me, that this piston, being the first one in the art—

Q. You mean the Spillman & Mooers piston? A. Yes. —was found difficult to make, manufacture, and Mr. Mooers tried to get away from the difficulty in this Spillman & Mooers patent, in his new construction shown in the Mooers patent, 1,402,309. His idea was that if he took this support for the skirt and moved it up to the top of the piston, putting it over against the side of the piston walls, as shown in the Mooers patent, he would get a piston which would be much more easily cast and of lighter construction. Is that what you had in mind?

Q. Yes. Did Mooers get as efficient a construction? A. I should say he spoiled the piston from an operative point of view.

Q. Is that a manufacturing question or a structure question that Mooers was faced with? A. Why, it was a manufacturing question, evidently.

Q. Now, will you compare Exhibit 1 with the Spillman & Mooers structure, using the two models, Exhibit EEE and 3-G, and point out any similarities? A. The construction shown in 3-G is similar to that of the Spillman & Mooers, in that the wrist pin boss is supported by a web which comes down from the head of the piston, although the web in the 3-G is sprung from the ring flange. However, I don't think that would be a material difference. The difference between the two is that Mooers or Spillman & Mooers shows his connection from the head to the bottom of the skirt, while the Exhibit 3-G shows the connection connecting the piston walls about near the top of the skirt.

Q. What have you to say about comparative efficiency of those two pistons? A. I should say that the Spillman & Mooers was the better design because of the fact that the heat is carried to the top of the skirt and distributed throughout the skirt, while in this design (indicating 3-G) the heat is carried directly to the top of the skirt where the expansion is greatest and where the flexibility is least.

Q. But the Exhibit 1, illustrated by model 3-G, is easier to cast, is that right? A. Yes.

Q. It can be cast in a permanent mold? A. It can be cast in a permanent mold, where Exhibit 3-E would be difficult to cast in a permanent mold.

(Short recess taken.)

Q. Now, briefly compare the Chenard and the Walcker patent structure with the Ray Day type piston, Exhibit 8, and state what difference you find between them? A. The first and most obvious difference is that the piston in Plaintiffs' Exhibit 8 is not split on the thrust side or the side opposite the thrust in the piston, as in the Chenard and Walcker patent. The ribbing on the inside of the piston is somewhat different than in the Chenard and Walcker patent, but the function of the piston, that is the flexibility of the piston, not taking into account the vertical slot, would be about the same as that shown in the patent. The piston is suspended by ribs springing from the head and going to the wrist pin bosses.

Q. Compare Exhibit 8 and the Chenard and Walcker patent and the Mooers patent in suit with reference to the connection from the head to the skirt; which two approach each other more closely? A. I should say the Chenard and Walcker patent was very much more like Plaintiffs' Exhibit 8 than it is like the Mooers patent, in that in the Mooers patent the connectors go directly from the head to the top of the skirt, while in the piston, Exhibit 8, the connectors go from the head to the wrist pin boss, as in the Chenard and Walcker patent.

Q. Which of the patents that you have discussed approaches most closely to the Mooers patent structure, assuming that the connectors at right angles to the wrist pin bosses are omitted? A. The Franquist patent, I should say.

Q. I believe you have discussed the Schmiedeknecht patent and the relation of the defendants' piston, the Ferry and the Pugh patents and the Spillman & Mooers patent. What do you consider the closest prior patent to the Schmiedeknecht patent, considering the feature of suspending or mounting the wrist pin boss between a web connected to the skirt and the head? A. This English patent 17,256 to Pugh.

Q. English patent to Pugh, 17256 of 1907? A. That is the one that seems to be the closest approach to the Schmiedeknecht patent 1,256,265 of any we have discussed.

Q. Now, taking up the Maynard patent, and in taking up this patent I want to call your attention to the Schmiedeknecht patent, and particularly the oil groove 13 with its oil holes 15, the specification of the Maynard patent states at page 1, line 12: "To avoid sticking or freezing of this skirt due to expansion, certain constructions of pistons have provided skirt with a longitudinal slot therein to compensate for expansion, but there is one serious difficulty with all of such constructions, viz, the tendency for the lubricating oil to work up beyond the skirt and rings and into the explosion chamber. This results in the formation of carbon and other difficulties incident thereto. With the present invention I have overcome this difficulty by arranging between the cylindrical ring portion and the skirt portion a continuous annular groove. This will receive the oil creeping past the skirt and permitting the same to drop back in the cylinder without providing any bridge for its passage to the ring portion." Now, as far as that statement is concerned,

what have you to say with reference to the Schmiedeknecht patent, which is a patent prior to the Maynard patent?

A. In the Schmiedeknecht patent we have this oil groove cut circumferentially around the piston and holes drilled through from this oil groove into the interior of the piston, which gives practically the same result as the construction shown and described in the Maynard patent. That is, in the Maynard patent we have the groove going all around the lower ring and the channel at J which also gathers oil, and the oil can return to the inside of the piston because of the slots shown here, and this relief being cut into the slots.

Q. Now in what way do the functions of the slot E compare with the groove 13 of the Schmiedeknecht patent? A. As far as returning oil back into the piston, I should say the functions were the same.

Q. What have you to say about the slots in the Franquist patent in that connection? A. The slot in the Franquist patent is used to carry the lower ring but would function much the same, particularly if a slotted ring was used in the lower groove.

Q. Well, what is the action if there is a ring in the piston groove during the reciprocation? A. Oil works back into the ring and in this case the piston back of the ring is cut away so that the oil can work to the inside of the piston.

Q. The rings are slotted, are they not? A. Yes, that is customary to use a slotted ring to keep the oil consumption down.

Q. Now, considering the Maynard patent in the light of Exhibits BBB and CCC and 3-J, as not contemplating any specific construction as shown there, and keeping that in mind, what does Exhibit CCC represent with reference to the prior patents that you have discussed, in particular a trunk piston in connection with something else? A. This is a trunk piston with the head separated from the skirt, with a longitudinal slot, and the same applies to BBB and Exhibit 3-J. That slot separating the head from the skirt in all three of these exhibits acts as a means of transferring the oil below the lowermost ring to the inside of the piston, much the same as the groove in the Schmiedeknecht patent, and also the groove in the Maynard patent, which we have just discussed.

Q. Now, compare the Maynard patent structure and piston Exhibit CCC to the Menckmeier piston 3-V and 3-W, and state if you can which two of those three are most alike? A. I should say the Menckmeier piston shown in Exhibit 3-V compares and is quite similar to the piston shown in Exhibit CCC, and also to the Exhibit BBB.

Q. What have you to say when you compare the Maynard patent, the Schoengarth patent and those three exhibits? A. I should say the Schoengarth patent more nearly compares to Exhibits BBB and CCC.

Q. What have you to say as to the Long patent 1,395,441, particularly shown in Fig. 2? A. That compares more nearly to Exhibits BBB and CCC.

Q. How about 3-J? A. And 8-J.

Q. What have you to say as to the Spillman patent 1,325,176? A. That compares in general to the piston BBB, CCC and 3-J in that it has the slotted skirt and contains a T-slot.

Q. What have you to say if I substitute the British patent to Hives, 140,988? A. That compares more nearly to BBB, CCC and 3-J.

Q. Now, compare the Hives patent, in particular with 3-O, which is a piston in which the skirt is elliptical, with the minor axis or the shorter axis along the wrist pin bosses; what does that compare most closely with? A. That compares with this patent we were just discussing, in that it has the T-slot on the thrust side of the skirt, which is the major feature of this Hives patent.

Q. Now, considering the Maynard patent and the Schmiedeknecht patent together with the numerous T-slots which are shown in patents all the way from 1917 to 1920, and also in the Monckmeier piston, what have you to say as to the Maynard patent structure, assuming that Schmiedeknecht and these prior structures were known to Mr. Maynard, which the law presumes they were? A. Why, it is evident to me that Mr. Maynard, having these T-slots, and the Schmiedeknecht patent, and so forth, before him, designed his piston with those things in view, putting in the T-slot in addition, and he accomplished about the same results that the others had accomplished.

Q. Where is the only place that Mr. Maynard could put a T-slot in the Schmiedeknecht patent structure?

A. In the skirt opposite the thrust side would be the logical place, running from the horizontal slot to the bottom of the skirt.

Q. Where would the circumferential part of the T naturally be put on the Schmiedeknecht patent structure? A. The circumferential part would be put at the top of the skirt below the lower ring land.

Q. Where would the vertical be put, for instance with reference to the reference numeral 15 as shown on Fig. 15? A. It would start at that point and run to the bottom of the skirt, practically vertically, so as to divide the thrust faces on the slipper portion of the skirt in two halves.

Q. Will you explain the action of a piston such as shown in the Maynard patent, in which there are no reliefs shown, in the drawing Fig. 1, with the action of a piston such as Exhibit 1? I hand you a diagram, and you might say if you have examined that diagram? A. Yes, I have examined the diagram.

Q. And put reference numerals on in making the illustration. First, tell the Court where that view is taken of Exhibit 1. A. The view is taken just below the slot, a section of the slot through the piston, in its vertical direction, just below this open slot. In this piston, or in all pistons, of course, we get an expansion on the diameter, and taking a radius point, in this sketch I have taken it at the edge of the relief, but if Mr. Bruninga wants to have it taken there, the same argument would apply.

Q. Take it where it is marked with the numeral A, for instance, where you said "there." A. At A. We

will have at least two forces due to expansion, taking place at this point. This one force will be on the diameter, through the center of the piston and extending out against the cylinder wall. This force would be represented by the vector, in this case B, and we have another force due to the expansion of the rib lengthwise, that rib growing in length, which we will represent by the vector C. Now, we will have a resultant force which we will call E, shown by the vector drawn between these two points and in the direction of the arrow on F. Then we will have, acting at this point or at this point—

Q. Acting at? A. At A.

Q. Or mark the other one G. A. G. We will have the force represented by the vector F in the direction shown, acting at the point A or the point G, which tends to push this portion of the piston out against the cylinder wall in this direction.

Q. You mean in the direction of the vector F? A. In the direction of the vector F. That has to be compensated for in some way in order to make the piston work. If it wasn't, and that force was exerted in this direction, the piston would burn.

Q. You mean in the direction of the vector F? A. In the direction of the vector F, it would burn or score, so that the action we get in this piston, Exhibit 1, is that this short web, the portion of the web from the point shown as A to the point G has to flex and allow the piston to leave the cylinder wall to a certain extent, or reduce the force acting at A or G by the amount of the flexure.

Q. Do the webs, if we can call the parts H webs, actually flex then at the top in Exhibit 1? A. No, these webs from this point represented by A, are integral with the head, so that there is no flexure of the web from this point back at the top of the web, as I see it.

Q. Now, explain any pushing out action along the wrist pin axis in Exhibit 1, and compare it with the Franquist patent, using in that connection the model, if you want to, Exhibit 3-G? A. Of course in that action we get an expansion along the wrist pin boss and in the direction of the wrist pin, which would tend to push the skirt, or portions of the skirt, out. This has been compensated for in this piston by the vertical slots, and that force is somewhat taken care of, although these ribs being as stiff as I have shown and as short, make that force rather difficult to compensate for in this design, more so I should say, than in the Franquist patent.

Q. Now, does the slot actually close as illustrated for instance in the diagram which you have referred to and which I will mark for identification Defendants' Exhibit 4-A? A. Why, as a matter of fact I think that what we get in this, and I believe practice bears us out, is that this portion of the skirt actually bends down towards the center of the piston in the direction of the arrow I. In that bending down, that relieves the pressure along the surface and we will get less friction due to the bending of this web or this skirt toward the center of the piston, but the slot does not close particularly.

Q. Well, will you get that action if you don't have any relief at all, as indicated from A to G in 4-A? A. No.

Q. Well, will you get any appreciable action?

Mr. Richey: I object to that as leading and trying to get the witness to contradict his other answer.

A. I don't think I would contradict it, Mr. Richey, necessarily in saying if this relief was not here these forces would be applied directly over the end of the rib so that they would get very little flexure of this skirt toward the center of the piston. It is perfectly evident to me that they put that relief in the piston because they had very heavy bearing over the end of the rib, and that is the reason why the piston was scoring and the piston didn't work satisfactorily at all without it.

Q. Now, in discussing the Franquist patent and referring to the fact that when the piston expands along the lines of the wrist pin then there is a contraction at right angles, is that your theory or do you have anything to substantiate that? A. Oh, no, that is a generally known fact in piston construction.

Q. Have you ever made a piston that took advantage of that? A. Yes, we made an oval piston of that design in the Franklin in 1922.

Q. Was that split up and down? A. No, not all the way, part way up the skirt.

Q. Part way, you mean from the top down? A. Part way from the bottom toward the top.

Q. Part way from the bottom toward the top? A. Yes. I don't know whether we have a piston here that shows that or not. Yes, like Exhibit B to some extent.

Q. In other words, as far as the top is concerned it was solid, is that right? A. Yes. We depended on the oval of the piston; it was solid except it was cut away,

in the slot, between the head and the skirt, on the thrust side.

Q. Do you consider a piston constructed as Exhibit 1, suitable for a Franklin engine? A. No, sir, I wouldn't say it was. I wouldn't consider it was flexible enough for practical operation in the Franklin engine.

Q. But you did use the Long piston as you have testified? A. Yes.

Q. Why was the Long piston used and suitable and why would not in your opinion Exhibit 1 be suitable for that Franklin engine? A. Because, referring particularly to the top of the skirt, the Long piston is very much more flexible at the top of the skirt than the Maynard piston and will operate because of this added flexibility, where the Maynard piston would not, in the Franklin engine.

Q. Do you consider pistons like Exhibit 1 but with no relief in the thrust faces, practical? A. I wouldn't call it practical.

Q. But Exhibit 1 has those reliefs? A. Yes.

Q. Of all of the patents that you have referred to as against this Maynard patent, which do you consider the most pertinent, considering the Maynard patent structure as addressed to a piston without relief opposite the wrist pin bosses, and separated from the head by two quarter circumferential slots, and split, having particular reference as an example to Exhibit CCC? A. You want to compare the Maynard piston?

Q. Which of the prior art, and if there is a group, why, you can so state, do you consider closest to Exhibit CCC? A. I would say the Franquist piston was closest to Exhibit CCC.

Q. But let's consider it as having a definite T-slot? A. Of course the Franquist piston has not a T-slot, if that is what you want.

Q. How about these various T-slot patents and the Monckmeier construction, considering it as a T-slot piston, now? A. This patent 1,174,092, the Schoengarth patent, would to my mind represent Exhibit CCC as closely as any. Also the Long patent 1,395,441, and Long patent 1,489,499.

Q. I am talking about the T-slot now? A. That has no T-slot.

Q. How about the Hives patent 140,899? A. That incorporates a T-slot as shown in this Exhibit CCC.

Q. Now, considering practically the exact structure shown in the Maynard patent, do you find any single pat-

ent or prior art before you that shows that exact structure? A. No, not that exact structure.

Q. How about the Schmiedeknecht patent, what does that lack? A. That lacks a slot.

Q. A T-slot, you mean? A. Yes.

Q. Now, considering the Jardine patent and considering it as a slipper piston, what patent that you have previously referred to does it most closely resemble? A. Well, it has some of the elements of the Ebbs patent, for one, 700,309; it has resemblance to the Long patent 1,872,772; it has resemblance to Schoengarth patent 1,174,092 because of the T-slot as shown.

Q. I am just considering it as a slipper piston, now, not as a trunk piston. A. And it has decided resemblance to the Ricardo patent 1,294,833. It also resembles particularly the piston shown in the Anderson patent 1,283,021.

Q. Now, as a slipper piston, how does it distinguish from the Ricardo patent? A. Why, aside from the slotting and with the natural dimensions shown, I should say it was very similar, practically the same design, with a somewhat different arrangement of the webs where the webs join the head.

Q. How about the Anderson patent in the arrangement of the webs? A. It is very similar to the Anderson patent. The Jardine patent is very similar to the Anderson patent as to the webs.

Q. Considering the Jardine patent structure now as a trunk piston, what prior art structures do you think it resembles? A. All prior art structures that have the T-slot would represent the Jardine piston.

Q. How with reference to the relief? A. And of course a slipper piston is relieved on the side, as practically all pistons have to be in some manner or other.

Q. Now, what is your understanding of the webs 25 of the Jardine patent structure, are they rigid or flexible? A. Flexible.

Q. Even at the top? A. Yes, to a certain extent.

Q. What effect does the depth of the slot have, Fig. 6, for instance, on flexibility? A. The deeper the slot the more flexible the web.

Q. Would you consider Exhibit 1 as a flexible web, at the top? A. Not to the extent as shown in Jardine, if that is what you mean.

Q. Well, would you consider it as a flexible web at all?

Mr. Richey: I object to that. He has already answered.

A. No, I don't think. As I have already explained, except for the relief as shown on Exhibit 1, I don't think there is any flexure at the top of the skirt where the skirt joins the web.

Q. I think I asked that too broadly. When you said to any appreciable extent, did you mean in ten thousandths of an inch, or what? A. Yes, I mean in, I might express it as one ten thousandth of an inch, but I mean any appreciable extent which would allow it to work satisfactorily in an automobile engine.

Q. If the Jardine structure does not have flexible webs, what have you to say as to the action illustrated in that diagram, Exhibit 4-A, with no relief? A. The action would be very much the same as shown in the diagram and as explained.

Q. I mean with no relief from A to G, that is what you understood? A. Yes.

Q. Now, with reference to the Gulick patent 1,815,733, in what way does that distinguish from the Spillman and Mooers patent? A. In general structure?

Q. Well, you can go ahead and give your explanation. A. The structure as shown in the Spillman and Mooers patent resembles the Gulick patent in that the skirt of the piston is suspended from ribs which spring from the head of the piston. In the Gulick patent, however, the difference is that the form of support or the web of the skirt passes from the center line of the wrist pin down practically, while in the Spillman and Mooers the point of support is somewhat nearer the lower end of the piston.

Q. In the Gulick patent the web structure goes all along the piston in Fig. 5, does it not, all along the skirt?

A. Yes, although the point of support, I should say was from the bottom of this U-shaped curve in the web to the lower end of the web just below the lower portion of the U.

Q. By that you mean in Fig. 1? A. In Fig. 1.

Q. I was referring to Fig. 4. The web really goes all the way along that piston, doesn't it? A. Yes, as shown here, as being carried the full length of the skirt.

Q. Would you consider that the tiny connection above 19, Fig. 1 of the Gulick patent, is a web connection which will flex? A. I would say not, no, sir, not to any appreciable extent. Most of the flexure in this pis-

ton shown in this view appears at the narrowest point of the web, right at the bottom of the U.

Q. That is, assuming the web to be flexible; you assume that, do you? A. Yes.

Q. Now, the Spillman and Mooers patent of course does not have the split 21? A. No.

Q. Now, with reference to the Chenard and Walcker patent, in what way does that distinguish from the Gulick patent, outside of the split? A. The Chenard and Walcker patent shows a construction where the ribs extend to the wrist pin boss and the skirt is suspended from the outer end of the same wrist pin boss. In the Gulick patent that construction is, I would say, considerably different.

Q. But I believe you said that the Chenard and Walcker connection in that respect was the same as the Ray Day, is that right, Exhibit 8? A. Yes.

Q. Now, in the Ebbs patent structure, that is patent 700,309, in what way does that distinguish from the Gulick patent? A. In that the skirt of the piston is hung on the cross-head and does not resemble the Gulick piston, as I see, in any particular way.

Q. Well, how about the connection of the head with the skirt? A. It does resemble it in that way, that is, the head is separate from the skirt in both patents.

Q. How about the skirt being split, whether or not it is split? A. They are split in the Ebbs patent and also in the Gulick patent.

Q. Now, you referred yesterday to locomotive and marine connections, and you have discussed a German patent, 176,988, and the White patent 1,195,936, as showing the distinction between a marine connection and the locomotive connection, and yesterday you referred to the Roots patent 19,559 as showing a locomotive connection of a putman? A. Yes.

Q. I hand you a photostat on which there is superimposed on the Ebbs patent the locomotive connection of the Roots patent, which photostat I will mark for identification Defendants' Exhibit 4-B. What is the pertinency of that or what does that convey to your mind? A. This shows the locomotive construction in the Ebbs patent, the Ebbs patent showing essentially a marine type of construction, as referred to the locomotive type as shown in 4-B.

Q. Where does the part represented by B and the wrist pin and its coupling to the cross-head, come from

in the Roots patent, what figure? A. It comes from Fig. 3.

Q. Can you tell me from the other views, for instance, Fig. 2, how the wrist pin is mounted in the cross-head in the Roots patent? A. It is held in by what we call a locomotive type of construction, where the bearings are on the outside of the rods.

Q. Well, what did the parts F and B refer to, I mean what are the parts on the opposite side of G, Fig. 4, these two parts? A. Those are the bearings.

Q. Where are they indicated in Fig. 3? A. There and there (indicating).

Q. To the right and left of the connecting rod B, is that right? A. Yes.

Mr. Bruninga: Your Honor, I offer in evidence as Defendants' Exhibit 4-C a decision of the Law Examiner of the United States Patent Office, dated April 4, 1924, in interference No. 49,569, involving the application of the Gulick patent in suit. Also as Defendants' Exhibit 4-D a decision of the Law Examiner on the same day in the interference 49,574, also involving the Gulick application of the patent in suit.

As Defendants' Exhibit 4-E a decision of the Law Examiner in interference 49,580, again dated the same day, April 4, 1924, and again involving the application of the Gulick patent in suit.

As 4-F, a decision of the First Assistant Commissioner, dated April 7, 1925, in interference 49,575, involving the application of the Gulick patent in suit.

Q. Now, Mr. Stellman, in Exhibit 4-C the Law Examiner stated: "It is common to make pistons of cast metal"; do you agree with him as to the date way back of 1917? A. Yes, sir.

Q. The Law Examiner further says that the French patent (having reference to the Chenard and Walcker 468,595) and the Spillman patent (having reference to 1,092,870) show all that is claimed except the longitudinal slot which is found in Ebbs and can accommodate circumferential thermal expansion. Do you agree with the Examiner in that, in that the slots in the Ebbs patent structure can accommodate circumferential thermal expansion? A. Yes, I should say they could.

Q. In Exhibit 4-D, the Law Examiner said: "The patent to Ebbs discloses all the elements of the count except a pair of wrist pin bearings depended from the

piston end and free from engagement with the skirt. It seems to be immaterial from a patentable standpoint whether the cross-head has one relatively long bearing or two short bearings for the connecting rod wrist pins and the cross-head bearing is free from engagement with the parts of the skirt opposite to the ends of the bearing. The patent to Ebbs alone is a substantial anticipation of the count." Do you agree with the Law Examiner that it is immaterial whether a cross-head has one relatively long bearing or two short bearings for the connecting rod wrist pin? A: Yes, so far as the operation of the piston is concerned.

Q. I believe you said that was the difference between the marine and locomotive practice? A: Yes.

Q. And in Exhibit 4-E the Law Examiner says with reference to the Spillman and Moders patent 1,092,870: "The pin bosses in the patent are obviously integrally connected to the head and to the lower part of the skirt, the latter connection at a point remote from the head being designed by the patentee to avoid as much as possible the transmission of heat from the hot piston head to the skirt." Do you agree with the Law Examiner in that respect?

Mr. Richey: Objection to that as leading.

Q. Do you agree or disagree with him?

Mr. Richey: Object to it as leading.

The Master: Same ruling.

A. I agree with him.

Q. He further says: "The natural and obvious reason would be to reinforce or strengthen the connection between the pin bosses and the skirt. This is accomplished in the Gulick piston by elongating the attachment of the rib to the skirt at points adjacent to the skirt, but any form of integral connection from the piston boss to the upper part of the skirt as well as to the lower part would be covered by the count. The point for decision is therefore reduced to the simple proposition: Is it patentable to connect the pin boss to the upper part of the skirt for any ordinary purpose, such as to reinforce the support of the skirt? If it should be found that the support of the skirt by connection to its lower part is insufficient, it seems clear that no more than common mechanical skill would be required to correct the defect and supply the remedy by additional connections or braces between the upper part of the skirt and the pin

boss. It is true the advantage sought by the patentee would be lost in part but an adequate support for the skirt would be just as necessary as the avoidance of undue heating and the loss in one respect would offset the gain in the other." What have you to say as to the Examiner's position from an engineering standpoint, not from a legal standpoint, now? A. I think he has taken a reasonable position there, namely, that the location of the rib inside, the point of support of the location of the rib, is not of great consequence.

The Master: We will take a recess to 1:30.

(Noon recess.)

(Thereupon at 1:30 p. m., the hearing was resumed.)

Q. In Exhibit 4-F the commissioner said, with reference to the Spillman & Mooers patent 1,092,870: "The Spillman & Mooers patent which was regarded as capable of modification in accordance with the Ebbs patent and in order to anticipate the count of interference No. 49,574, does not disclose flanges connecting with the skirt on both sides, but the connecting member is in the form of oppositely apertured cylindrical portion having a flared, more or less or disk-shaped bottom, which is connected to the skirt below the bosses. The functional limitation at the end of the count implies a yielding in the connecting flanges, as otherwise a skirt with a single slit would not be freely expansible and contractible. The disk-shaped connector of Spillman & Mooers would have a stiffening or trussing effect on the skirt so that even if slotted, as suggested in the count, the skirt would be substantially unyielding." Is it your opinion, having the proportions of the Spillman & Mooers patent 1,092,870, that if the structure were slit as in Exhibit 3-P that the bottom of the skirt would be unyielding, and in this connection you might consider any influence that the wrist pin has on that structure. A. While the wrist pin is comparatively tight in this piston as shown in Exhibit 3-P and for that reason would tend to limit the yielding of the piston skirt, it is possible to make this piston skirt flex with the hands, and I should therefore say that the piston skirt was very flexible.

Q. Do you agree with the commissioner then, that the structure of the Spillman & Mooers patent is such that even if slotted, the skirt would be substantially unyielding? A. I should say not. I should say he was wrong.

Louis M. Stollman, Direct Examination

Q. Now you have considered the Gulick patent structure and leaving out of consideration any flexible webs but a structure in which the skirt will yield or in which any part of the skirt will yield, and considering the Gulick patent structure and Franquist patent and Defendants' Exhibits CCC, BBB, and 3-J, which two resemble each other the closer? A. I should say that Exhibits 3-J, BBB and CCC more resemble the Franquist structure than the Gulick.

Q. What would you say as to Exhibit 1, considering the inside part as a pushed-in relief? A. Exhibit 1 resembles Exhibits CCC, BBB and 3-J with the side walls of the piston brought out so that the relief was only partial.

Q. Now, consider the Franquist patent, the Monckmeier pistons 3-V and 3-W and taking again defendants' piston and the Gulick patent structure? A. The Monckmeier piston, Exhibit 3-V resembles CCC, BBB and 3-J.

Q. How about Exhibit 1? A. Exhibit 1, the Monckmeier construction would resemble Exhibit 1 with the skirts brought out so the relief was moderate.

Q. Do Exhibits BBB, CCC and 3-J have any webs on the inside at all? A. Yes, each one of them has vertical webs between the wrist pin boss and the head of the piston.

Q. Does Exhibit 1 have any web which is flexible at the top? A. No, sir.

Q. Well, take the Schoengarth patent, leaving out the adjustment connection and consider that patent and Defendants' Exhibits BBB, CCC, and 3-J as a group, and the Gulick patent, and state where you find most resemblance between any of the two. A. It seems to me that this Schoengarth patent resembles more the Exhibits, CCC, BBB and 3-J to much greater extent than the Gulick exhibit.

Q. How about Exhibit 1? A. The same would apply to Exhibit 1. Exhibit 1 with the skirt brought out, with the relief brought out more nearly to the skirt, would resemble the Schoengarth patent more nearly than the Gulick.

Q. Now, considering now the Ray Day piston, Exhibits 8 or 9, do you find any inside webs in that corresponding to the webs of the Gulick patent, that is, not the webs going to the top of the head, but going to the skirt, such as 17 and 18? A. No, I don't find any webs from the wrist pin boss to the skirt as in the Gulick patent.

Q. What have you to say about the piston Exhibit 3-O, does that have any webs on the inside? A. None except in the head.

Q. None? A. None from the wrist pin bosses.

Q. None going from the wrist pin bosses directly to the skirt? A. No.

Q. When you said "similar," did you have in mind structure or mode of operation? A. Functioning.

Q. The functioning? A. The functioning would be more nearly similar.

Q. How about structure; what can you say as to that? When you say the word "similar," more similar, for instance, to one than to the other. A. When the structure refers to the webs, I would say that was more similar in this to the Schoengarth patent than to the Gulick.

Q. Now, considering the Gulick patent from the standpoint of a piston having wrist pin bosses and connected to the skirt and to the head, what prior art structure, what particular patents resemble Gulick—most, in your opinion, of the ones which you have, if you can pick out one or two patents, whether or not they are split, that is, the arrangement, as for instance, shown in Exhibit 3-R? A. Chenard & Walcker is one which has somewhat the same arrangement, as far as between the head and the wrist pin bosses is concerned. The Ebbs patent, in so far as being a crosshead section supporting the piston skirt or slippers. The same would be true in the Anderson patent; in the Ricardo patent.

Q. The Ricardo patent is later; you need not consider that. A. And the Spillman & Mooers.

Q. You mean the Spillman & Mooers patent 1,092,870? A. That is right.

Q. Which do you consider the best one as illustrating most closely the Spillman & Mooers, the Chenard & Walcker or the Ebbs? A. Spillman & Mooers without the slotted skirt. I think all three of them read quite directly on that piston.

Q. Now, when you come to functioning, going back to 1917 or even back of 1915 with a filing date, what do you consider the most pertinent reference as far as functioning in a manner that Plaintiffs' Exhibit 1 is concerned? A. Back of 1915?

Q. Yes, in a filing date,—functioning as this piston, which do you consider the best and most pertinent, now a split proposition and not an unsplit one, actually showing a slitted proposition? A. Perhaps the Ebbs.

Q. How about the Franquist patent as far as functioning and mode of operation is concerned? A. I should not think the Franquist patent was so nearly the Gulick as some of the other pistons.

Q. I didn't ask you that. I thought you misunderstood me. I asked you which is the most near in function to Plaintiffs' Exhibit 1? A. I should say that the Franquist patent did function as Exhibit 1.

Q. Do you know E. G. Gunn? A. Yes.

Q. Did you know him in 1920? A. Yes.

Q. Who is he connected with? A. The Packard Company.

Q. In what capacity? A. As an engineer.

Q. Have you met him in meetings of the Society of Automotive Engineers? A. Yes.

Q. In the issue of Automotive Industries, of January 29, 1920, page 362, in an article written by Mr. Gunn, he says: "Pistons of the Long and Franquist patent are split to allow the piston to spring. They can for this reason be fitted more closely than the more conventional types." What is your opinion as to that? A. I should think he was right as of that date.

Q. Can you tell me what type piston is illustrated in Fig. 8 on page 363 of that article? A. That is the so-called Long type.

Q. Can you tell me what piston is illustrated in that figure? It has no number,—the left view at the left of the page on page 364? A. That is the so-called Franquist type.

Mr. Bruninga: I offer in evidence a photostatic copy of the three pages, 362, 363, and 364 as Defendants' Exhibit 4-G.

Mr. Richey: We object to it as incompetent and immaterial, and not set up in the answer.

The Master: Same ruling. What date is that?

Mr. Bruninga: January 29, 1920.

Mr. Richey: So far as the facts contained therein are concerned, it is objected to as hearsay.

The Master: Same ruling.

Q. Do you know whether Mr. Gunn is still connected with the Packard Company? A. No, I don't.

Q. As you will note in Exhibit 1, there is this relief cut on each side in the thrust faces. Do you actually find any such relief illustrated in the Maynard patent, any relief cut into the face? A. No; I should say that there wasn't any relief shown in the Maynard patent

because it shows that the skirt comes out beyond the point of contact with the webs.

Q. Would it make a particle of difference with no relief whether that skirt itself with the webs behind it were inclined or were not inclined? A. I should say not.

Q. Did you ever meet Mr. Jardine? A. Frank Jardine?

Q. Yes. A. Yes, sir.

Q. Did he offer you any aluminum pistons? A. Oh, yes. Mr. Jardine has offered us pistons from time to time, I think.

Q. What indicates the relief in Exhibit 4-A, between what two points? A. Between the points indicated by the letter A and the letter G.

Q. Who paid you for your services in St. Louis? A. You did.

Q. Were there any services outside of testifying in that case? A. No, unless you would call some service in connection with getting information for that testimony.

Q. Well, you spent a number of days, didn't you? A. Yes.

Q. What was your time spent on? A. Looking over the patents.

Q. These patents in suit? A. These patents in suit.

Q. And any of the prior art patents that we have now? A. Prior art patents, yes.

Q. I retained you in St. Louis, though, for this case, didn't I? A. Yes.

Q. Did I consult with you with reference to the prior art and your knowledge as to the art? A. Yes, sir.

Q. Outside of the fact testimony in the Long matter? A. Yes, sir.

Q. Did you render me any bill for the days you actually spent on testifying as a fact witness for Long? A. I don't think the bill took into account the fact testimony as much as it did the expert part.

Mr. Bruninga: Take the witness.

CROSS EXAMINATION by Mr. Richey.

Q. In 1915 and 1916 I understand you were familiar with the pistons that were in use at that time, weren't you? A. More or less.

Q. You have a pretty good knowledge of all the pistons that had any substantial use at that time, didn't

you? A. I don't know as I could say all of them, but some wide knowledge in connection with pistons at that time.

Q. And during 1917 and '18 you learned still more of them? A. Yes, I should judge so.

Q. The Franklin Company had kept in touch with the patents issued on the automobile accessories they were interested in, didn't they? A. Yes, they had some one in their organization that kept in touch with it.

Q. And during the period there when they were trying to develop a piston, they kept in contact with the patents on pistons, didn't they? A. I don't think we paid so much attention to the patents while we were developing a piston as we did perhaps after the development had proved a success.

Q. Well, nevertheless, you kept in touch with the piston as an accessory, the same as you did with the other accessories, didn't you? A. Oh, yes, we tried to be up to date in connection with piston design.

Q. Now, take this piston of the Hives British patent. How many patents did you refer to—you haven't got a list of them, have you?

Mr. Bruninga: I want to offer all these in evidence in one book and get them together. Mr. Richey can make his objections at that time.

The Master: Let them be offered as the next exhibit for the defendants.

Mr. Bruninga: I offer in evidence all of the copies of all of the patents referred to by me in this case as Defendants' Exhibit 4-H.

Q. Take the piston shown in the Hives British patent 140,988: was that piston as shown in that patent ever used commercially, to your knowledge? A. The particular piston as shown, I don't know.

Q. You don't know whether it has been used commercially? A. No.

Mr. Bruninga: This is actually immaterial, whether any of these pistons have gone into use at all, and I want to make that point and make that an objection. Although commercial success is considered by some courts, even by a prior art device.

The Master: Well, the question has been answered.

Mr. Richey: Want to hear from me on that? Because I am going to ask a lot of questions along that line.

The Master: I think I should let the testimony in over your objection.

Mr. Bruninga: I think you should let it in, because there is a difference of view of the courts to what extent commercial success of the prior art structure will be considered; but I want to make an objection to all questions relating to the commercial success of any prior art structure.

The Master: That objection will be regarded as entered. You may go ahead with your examination and it will not be necessary to enter the objection again. So far as that is concerned, it will be considered as made to all questions along that line.

Q. Would your answer be the same with respect to the pistons shown in the Hartog patent 1,842,022? A. I never knew that that piston was actually used.

Q. How about the piston shown in the Anderson patent; would your answer be the same? A. Yes, sir.

Q. Would your answer be the same about the piston shown in the Ebbs patent? A. Yes, sir.

Q. Now, about the piston shown in the Franquist patent 1,153,902, would your answer be the same about that? A. I understand—

Q. I am asking you, of course, about your own knowledge. A. Well, this is my knowledge.

Q. You started out by saying you understood. A. Isn't that my knowledge?

Q. If that is your knowledge, all right. A. I understand that this piston has been used commercially, or a similar piston.

Q. And you know that of your own knowledge, or that is what you heard? A. I never saw it in actual operation, if that is what you mean.

Q. When did you learn it had been used commercially? A. Around 1920, I should say, thereabouts.

Q. Do you know whether or not the piston shown in the Long patent 1,395,441 was ever used commercially? A. No; to my knowledge I don't know that that one ever was used commercially.

Q. Do you know of your own knowledge that the piston shown in the Spillman & Mooers patent 1,092,870 was ever used commercially? A. That is this piston shown in Exhibit 3-P?

Q. No, the one shown in the patent. A. This piston without the slot?

Q. Will you answer with respect to the one shown in the patent, first? A. Yes, I understand that that has been used commercially.

Q. You don't know that of your own knowledge? A. I haven't seen it used.

Q. When did you learn that they were used? A. When I was with the Franklin Company, I should say around 1918, '19, '20, somewhere.

Q. It was during the period when the Franklin Company was trying to get a satisfactory piston for their engine, wasn't it? A. Yes. We have always tried to do that.

Q. I mean it was during the period when you were —well, what piston were you using at that time? A. I should say we were using the Long piston, Mr. Richey, if my memory serves me right.

Q. That was after 1919, wasn't it? A. Yes, in 1919 or '20, at least we were doing experimental work with the Long piston.

Q. Well, the use of this Spillman piston shown in the Spillman & Mooers patent was very limited, if you didn't know about it up until then. A. I wouldn't say it was generally used.

Q. Used only by this company of Spillman's, wasn't it? A. Yes, and I think the Sterling Motors Company used it.

Q. And neither one of them lasted very long, did they? A. The pistons might have lasted quite a while.

Q. Well, I say the companies didn't last very long? A. I don't know, Mr. Richey, about that.

Q. Well, you know they soon went out of business? A. No, I don't. I know they went into the hands of a receiver.

Q. Take the piston shown in the Spillman patent 1,229,540: was that ever used commercially to your knowledge? A. No; I can't say that I know that that one was used commercially.

Q. Do you know which one of the two was used commercially; the one shown in Spillman & Mooers patent or the one shown in the Spillman patent? A. I understood the one shown in the Spillman & Mooers patent.

Q. But you don't know of your own knowledge which it was? A. I didn't see it.

Q. You don't know whether the piston you heard was used was exactly like either one of them? A. No, I don't.

Q. Do you know if the piston shown in the Vincent patent 1,279,184, was ever used commercially? A. I don't know whether it was.

Mr. Bruninga: I believe, your Honor, that this particular plaintiff is estopped to deny that, because suit was brought against Mr. Long in which it was stated that these pistons, including those of the Vincent patent, had gone into wide commercial use, and to ask this witness now and try to dispute that—

Mr. Richey: Of course your statement about that is not evidence. I don't know whether it is right or wrong. I don't dispute or deny it.

Mr. Bruninga: I will introduce the bill of complaint in that suit against Mr. Long, including the Spillman patent. I have it at the hotel.

Q. Vincent is the Col. Vincent who for a long time has been chief engineer of the Packard Motor Car Company, hasn't he? A. Yes, sir.

Mr. Bruninga: Did he say had no commercial success?

Mr. Richey: He said it had none that he knew of.

Mr. Bruninga: I take it my objection is overruled?

The Master: Yes.

Q. Take the pistons illustrated in the British Rainforth patent of 1912, 6826: were either one of those ever used commercially, to your knowledge? A. Not to my knowledge.

Q. The same question about the piston shown in the British patent to Pugh, 17,256? A. I don't know if that was used commercially.

Q. The same question about the piston shown in the British patent to Perry, 12,772? A. I don't know that that was used commercially.

Q. Same question about the pistons shown in the French patent to Chenard & Walker, 468,595. A. No, I don't know if that was used, either.

Q. Would your answer be the same with respect to the Howe patent? A. No; I should say that had been used in, at least so far as the patent was concerned, in the making of pistons that has the oil groove.

Q. Who used it? A. Franklin used it for one.

Q. That is, with the oil groove in it? A. Yes.

Mr. Bruninga: I am wondering whether the witness really understands that question. Do you understand the question to be whether somebody was licensed under that particular patent or whether a structure like shown in the patent went into commercial use?

The Witness: Well, the Franklin Company was licensed under the Howe patent, I think.

Mr. Bruninga: I wanted to get that clear. What did you understand? Whether the patented structure illustrated in the patent, or whether somebody was licensed under the patent?

The Witness: I understood he asked if that construction shown in this patent was used by Franklin.

Mr. Bruninga: And you understood that about all the others?

The Witness: Yes.

Q. Take the Schoengarth patent: has that piston illustrated in that patent ever been used commercially to your knowledge? A. Not that particular type, no.

Q. This piston shown in the Spillman patent 1,325,176: was the piston shown in that patent ever used commercially to your knowledge? A. That is the Kantakore. I think it has been, yes, if that represents the Kantakore piston.

Q. Well, it failed, didn't it? A. No, no, that was fairly successful.

Q. It just busted the company, didn't it? A. I couldn't say.

Q. Well, you know they discontinued it and manufactured pistons substantially like Exhibit 1, don't you? A. Yes; but that might have been because one was a better piston than that; not because it failed.

Q. You think the piston Exhibit 1 is a better piston than the one shown in the Spillman patent 1,325,176? A. Piston 1 is not a very good piston, in my estimation.

Q. That is not the question I asked you. I asked you whether it was a better piston than the one shown in the Spillman patent. A. I wouldn't say that it was, no.

Q. Then you don't agree. You want to take back what you said about the Kantakore taking up the piston of Exhibit 1 after the Spillman? A. I don't know what the Kantakore was making until I heard you say it was or did. My familiarity with the Kantakore and the Aluminum Industries is rather meager.

Q. All you know about Kantakore using the Spillman piston is what you heard? A. I knew they used the Spillman piston, yes. But I don't know much about their success with Exhibit I.

Q. In your opinion, the piston shown in this Spillman patent 1,325,176 is a successful commercial piston? A. For replacement purposes I consider it rather successful.

Q. Would you say the sides would not collapse in use? A. Depends on how it was made.

Q. Well, made like shown in the patent. A. I understand they did have some trouble.

Q. Had a lot of trouble; you know that? A. I understand that.

Mr. Bruninga: May it please the court, I didn't know it was going to drag out so long, but here is the situation: some of the reports show the plaintiff in this case collected royalties on that particular piston, and a blue-print is shown attached to it, and it seems to me all this talk of having the witness try to show the piston is no good at all doesn't set very well. I object to it as not proper in this case on account of the position that plaintiff has taken.

Mr. Richey: Mr. McCoy tells me, that Mr. Bruninga's statement is incorrect; that royalties were not paid upon a piston like shown in this Spillman patent 1,325,176.

Mr. Bruninga: You dispute my word on that, do you, Mr. McCoy?

Mr. McCoy: The character of pistons on which royalties were paid over the period that has been testified to here was split only on one side. The thrust face of that piston was supported by internal ribs running circumferentially around the piston skirt, and it is my information that the Kantakore Company ceased to manufacture the Spillman type of piston about 1922—no, about 1920, I believe; some time around 1920.

Mr. Bruninga: I show then a report which has been produced by—

Mr. Richey: Are you going to argue the case now or go ahead with this witness?

Mr. Bruninga: I want to settle the matter, whether you can go ahead in that way. Report of June 30, 1927, which has been produced by the Cleveland Trust Company, a photostat of it which I have marked for identification Defendants' Exhibit

4-I, and which shows attached thereto clearly a piston of almost identically the same construction as shown in that Spillman patent; it is drawing No. 433.

Mr. McCoy: Your Honor, the drawing does not show—

Mr. Bruninga: Now, Mr. McCoy, you can call a witness if you want to on that, or you can go and take the witness stand yourself if you want to.

Q. Now, as a matter of fact, Mr. Stellman, you know that Kantakore Piston Company had a whole lot of trouble with this piston shown in this Spillman patent 1,325,176? A. No; as a matter of fact I don't know how much trouble they had.

Q. Now, let's look at this Long patent 1,489,499: was that piston ever used commercially, to your knowledge? A. No, sir.

Q. Was this piston shown in the White patent used commercially to your knowledge? A. No, sir.

Q. Was the construction shown in the French patent to Serex 434,147, ever used commercially to your knowledge? A. No, sir.

Q. The one shown in the Pomeroy patent 1,499,073: was that ever used commercially? A. Not that I know of.

Q. You know that Pomeroy is an internationally known automobile engineer, don't you? A. Yes, you can call him international: he is known in two countries anyway.

(Short recess taken.)

Q. Mr. Ricardo was also an internationally known automobile engineer, wasn't he? A. Yes, sir.

Q. Now, as I understand it, when you were working with the, first went to work with the Franklin Company, they were using an iron piston, is that right? A. That is right.

Q. Trunk type piston? A. Yes.

Q. And for an air-cooled engine? A. Yes.

Q. So the question of the heat was a greater problem with them than with the water-cooled engine; is that right? A. Yes, that is true.

Q. And what clearance did you use with the iron piston? A. As I remember, we used 3-5, 3 at the bottom of the skirt and 5 at the top.

Q. And the first aluminum piston you used was a trunk type piston? A. Yes.

Q. And when was that put in? A. That was put in about 1916.

Q. And what was the clearance? A. 8-11, as I remember it; 8 at the bottom and 11 at the top.

Q. And from then on, at least up until 1920, your effort was to secure an aluminum piston that would reduce that clearance; that is right, isn't it? A. That is right.

Q. And avoid the slapping, sticking, and scoring? A. Yes.

Q. Now, you also tried Magnalite pistons, didn't you, in that period? A. Those were the ones made by—

Q. What do you mean by Magnalite? A. I say is that the trade name of the Walker-Levett Company?

Q. Do you know whether it is or not? A. I am asking you if it is.

Q. Yes. A. We did use it.

Q. And you tried the Lynite piston? A. Yes.

Q. And you split the skirts of both the Magnalite and the Lynite up part way from the bottom, like in Exhibit B, did you? A. Yes.

Q. You also tried light weight cast iron pistons known as the Wainwright piston, didn't you? A. Yes; we tried some of those.

Q. You tried slipper type pistons, didn't you? A. I don't remember that we actually tried the slipper type like shown in the Jardine patent, for instance.

Q. Well, you tested out slipper type pistons with the idea that you might use them if successful? A. I don't think we ever tested that particular type of Jardine.

Q. I wasn't asking you about Jardine; I was asking you about what you call the slipper type piston. A. If you call the Long type a slipper type piston, we did.

Q. I am not saying yes or not how I classify the Long type piston. But didn't you try pistons generally like such shown in the Anderson patent, or in one of the other patents your counsel said disclosed the slipper?

Mr. Bruninga: Ricardo?

A. No, sir, we never tried that to my knowledge.

Q. Then you tried pistons with the slit part way up from the bottom, like Exhibit B, with the Stellman rings in them? A. I never heard them called that kind of ring; but we tried some that expanded along at the bottom.

Q. These rings you used to expand them out, such as shown in the Van Bever patent? A. That is right.

Q. Did you try a piston called the Zephyr piston?
A. I think we did run some tests on a set of those.

Q. Did you try a short skirt Wainwright piston? A. I don't remember it by that designation.

Q. You tried several types of composite pistons in that period, didn't you? A. Yes, sir.

Q. Then you varied the thickness of the side walls, didn't you, of the piston? A. Yes.

Q. And you tried pistons that were tapered and pistons with straight skirts? A. Right.

Q. And pistons with off-set pin bosses? A. Yes, sir.

Q. Then you tried pistons made of various metals, including aceril, abc, macadam, and deltum? A. You are bringing back a lot of memories; I had forgotten all about those things.

Q. Well, you did try all of them? A. I think we did.

Q. And that was when you were chief engineer?
A. I wouldn't say that; when I was employed by the Franklin Company.

Q. As an engineer? A. Yes.

Q. And any suggestion that you would make about improving the piston, I suppose, was considered and perhaps tried out? A. It might have been, yes.

Q. Did you try anything else to reduce this clearance and prevent slapping and scoring and sticking during that period? A. I think you have covered the ground rather thoroughly.

Q. I suppose you and the other engineers down there gave a good deal of thought to this solution? A. Yes, sir.

Q. The piston question when all those things came along? A. Yes, sir.

Q. And many schemes were submitted to you by people from the outside during that period? A. Yes, I would say some.

Q. And they were considered? A. Yes, sir.

Q. When was that slit ring put in the piston? A. As I remember it we never put that in the production piston. It was used by the service department of the Franklin Company for pistons already in service and for some pistons that they sent out from the factory to go into cars in service.

Q. That is, you are talking about the piston in the Van Bever patent now? A. With the slit ring.

Q. When was it first used in service? A. I would say the early part of 1917, around there some time; I can't tell you the correct date.

Q. How long was that used? A. Oh, it was used more or less until we used the Long piston.

Q. To your knowledge were other automobile companies than the Franklin during that period working on this problem of reducing the clearance with the aluminum piston? A. From the period 1915 on?

Q. To 1920, we will say? A. Yes, sir, they were.

Q. And how general was that problem being worked on at that time? A. Quite general, I should say. I know of one other company that used them more or less in that period.

Q. Those who were working on it would include the leading engineers of the leading automobile companies of the country, wouldn't they? A. Yes.

Q. I call your attention to Defendants' Exhibit H and to the figures there under the head "Well known types of pistons." What do those figures mean down there? A. That compares the general dimensions of the piston as outlined in the text between the so-called oval type piston and the Long type piston.

Q. What do you mean by the "oval" type and the "Long" type? A. The oval type was the piston something like Exhibit B, but ground so that a section taken through the wrist pin boss, for instance, would have an oval shape, the largest diameter of the oval being in the direction of thrust, the shortest diameter being parallel to the wrist pin.

Q. Did the Long type mean the one shown in this Long patent 1,872,772? A. Yes.

Q. That is, it was the type of Long piston that was used commercially by Franklin at that time? A. Yes.

Q. Referring to your drawing Exhibit 4-A and to the relief on the same at the edge of the connection between the thrust face and the webs, would you say a piston would be inoperative without that relief? A. I would say it would be very apt to score at the point at the end of the web.

Q. You don't say it would be inoperative? A. I don't say you couldn't operate it, no, under any conditions; but I say under severe conditions.

Q. You don't say the piston shown in the Maynard patent is inoperative? A. Not under any conditions; but under severe conditions.

Q. You look at Plaintiffs' Exhibit 21: that doesn't show any such relief as you mentioned, does it? A. I don't see any relief.

Q. Would you say that piston would be impracticable? A. Well, it all depends on what clearance you are going to run these pistons with, Mr. Richey.

Q. Well, at what clearance would you say this piston shown in Exhibit 21 would be an impracticable piston? A. In what motors?

Q. Well, what motor do you have in mind when you are talking about any piston being impracticable that didn't have relief, as you have shown in Exhibit 4-A? A. That which I had in mind was the average water-cooled motor, like the Ford.

Q. Let's take the average water-cooled motor like the Oakland: do you think that comes within your definition? A. Well, if this was a production Oakland motor; I don't know what motor that was; whether that was a production piston or an experimental piston; but I know what you mean if you don't say it.

Q. What I am asking you is: here is a piston,—you have said this piston shown in Exhibit 4-A would not be practicable unless you had that relief. I am asking you the same question about the one shown in Exhibit 21. A. I should rather see a section taken through that piston similar to the section like that, so that I could get an idea of the length of that web that was free there, before I made the statement.

Q. That is, you cannot express an opinion as to the practicability of the piston shown in 21, as shown in that drawing? A. No, sir.

Q. You haven't got enough drawing? A. I have got drawing enough, but I haven't the instruments and the ability to make a sketch showing how it would operate.

Q. What all would you like to have? A. As I say, I would like to have a section through that point just below the rib.

Q. What instruments would you like to have? A. A drawing-board and compass; I would like you to have a section made of that drawing at that point; then I could give you my opinion.

Q. You have three or four sections on there? A. There is not any section just at that point. That is why we made this section of that piston there, of Exhibit 1.

Q. Well, how many drawings do you have to have of a piston to tell whether it is practicable or not? A. Well now, is that necessary?

Q. Yes, that is necessary. A. I don't know how many; enough to get the information, that is all.

Q. Now, isn't it a matter of fact this drawing that I have shown you, Exhibit 21, is the kind of drawing that is submitted by the casting manufacturer to the motor manufacturer in connection with the sale of castings and from which the casting is machined? A. That is the detail of the piston, yes, to make a piston from. But I would not say that necessarily would furnish an engineer with enough information, with just what is on that drawing, to say whether that piston would work or not.

Q. If you had that drawing and the casting, would you know how to make the piston? A. Yes.

Q. And that is the kind of information that is furnished by the manufacturer of the casting to the motor car manufacturer with the castings, and from that the pistons are made; that is correct, isn't it? A. Yes.

Q. Now, you know very well the reason you are not answering that question is that you know that piston has been used commercially, don't you? A. No.

Q. You don't know that? A. No, sir.

Q. Now, I am going to ask you the same question about Exhibit 22, assuming that there was no relief, as shown at H, would such a piston be a practicable piston, even without that relief? A. Well, Mr. Richey, you are asking for an opinion on a design which I say would require considerable consideration.

Q. Well, how long do you want to consider it? A. I don't want to consider it at all; but if you wanted to know my opinion, I would like to have you furnish a section through that piston similar to the section we have taken through Exhibit 1.

Q. That is, you have got a view here along the line B-B, haven't you, shown down here (indicating lower right hand corner)? A. Yes.

Q. And you have got the same thing over on Exhibit 21? A. Yes, but these are different.

Q. Now, how far below these sections would you want a section taken? A. Just to show this piston skirt.

Q. Just about— A. Just about $\frac{1}{2}$ " below.

Q. The only difference between the section B-B and the one you want is that the thrust faces would be shown in section instead of in elevation; isn't that right? A. No, that is not the only difference.

Q. And then it would be cut off on the boss? A. But if this piston did operate satisfactorily, why did they put that relief in there?

Q. That is not what I asked you.

Mr. Bruninga: Referring to Exhibit 22.

Q. You know they make improvements in these pistons; but my question was: without that relief would it be a practical piston, in your opinion? A. I should not think so, no.

Q. Now, can you answer the same question about the piston shown in Exhibit 21 you have answered about the other one, without the section you had to have? A. There again, the question of clearance enters, and they don't show on those drawings what clearance those pistons are supposed to operate with. I see they have a place for it there, but it is not on the drawing; perhaps they were afraid to put it on. We have got to have more information than that, if you are going to design a piston for any given motor.

Q. You would have to have the clearance given you before you can say whether any piston is practical or not?

A. Yes; what clearances you want to operate with; what temperature you want; how much speed you are going to try to get out of the motor; and a lot of things.

Q. You couldn't tell how a piston operates without knowing the clearance? A. That would be one factor, I think.

Q. That is not the question. (Question read.) A. That is one factor.

Q. Well, you would have to have the clearance? A. Yes.

Q. Now, let's assume, suppose the clearance at which the piston shown in Exhibit 21 was operated was .001" per inch. You understand what I mean by that? A. Yes. Then it would be a practical piston. I should say that would be a pretty stiff piston to operate at .001".

Q. Even so, it would be practical? A. No, I don't think it would.

Q. You think it would be too stiff to be practical? A. I am talking about operating under severe operating conditions.

Q. I am talking about general run of mine commercial conditions: you would think this piston here would be too stiff to be a practical piston? A. I don't know what you mean by "run of mine."

Q. I mean every day driving of motor cars, day in and day out, for example. A. I don't think that piston would run in the Franklin car.

Q. We started to talk about a water-cooled car. A. You mentioned the Franklin.

Q. You think it is too stiff to be a practical piston for common usage? A. It looks like a pretty rigid construction to me.

Q. Of course, that doesn't answer my question. I want to know whether it is too rigid to be practical. A. I would say they would have quite a lot of trouble with that piston for piston slap, if they ran it at clearance enough so it wouldn't freeze or stick.

Q. I suppose you would say the same thing about the piston shown in Exhibit 22 without the relief on there? A. Yes.

Q. Now, this relief that you spoke of, shown in Exhibit 4-A, improves the operation, does it? A. I should judge so.

Q. What do you think makes this piston shown in Exhibit 21 stiff? A. Well, in the first place I don't see that there is any flexibility shown in those ribs, particularly.

Q. The ribs in the heads, you mean? A. These ribs here. There is no slot in the skirt—oh, yes, there is a slot shown on one side. In other words, it is a piston somewhat similar to Exhibit 1; is that right?

Q. Yes, my understanding of it. Now that you have seen the slot in there, do you still say it would be too stiff? A. I would say it would be a pretty stiff piston at that.

Q. Do you think that would be as stiff as this Exhibit 3-Q? A. Well, Exhibit 3-Q is a different design. It might not be stiff in the same places.

Q. In what way is it different; in what way is 3-Q different from the one shown in 21? A. Well, these slots, these four slots in the surface, that has one. This has the wrist pin bosses supported by the skirt, and this has them supported by the webs. And the skirt is made with a small relief on this, and made with a large relief on that. The two pistons are not similar in design.

Q. Well, do you say—I asked you about the stiffness—do you say they have a different kind of stiffness? Why do you say they would have a different kind of stiffness—because of the differences in design that you point out? A. Yes.

Q. Do you find any other differences in them than those you have mentioned; I mean in design, structure?

A. Oh, the only thing common is that the thrust surfaces of the pistons are separated from the head.

Q. Is that the only thing you find common between those two pistons? A. That is one thing in common.

Q. But still you haven't said which is the stiffest. A. I couldn't tell that without testing them.

Q. In other words, to express any opinion on these pistons, you would feel that you ought to test them; is that right? A. I do, between those two, to test the absolute stiffness.

Q. You were asked which of the prior art constructions that have been relied upon here, including the patents, you thought was nearest the Gulick. As I understood you, you named several, including the Ricardo. Now, which one of all do you think comes nearest embodying the improvements of the Gulick patent? A. I should say that Ricardo came as close to it as any.

Q. What would be your second choice? A. Let's see: what three did we pick out?

Q. Can't you answer without looking? A. I would have to refer to the three.

Q. Well, take the whole bunch of them there. A. I would say the Long piston came next.

Q. That is patent 1,872,772? And which one do you think is next? What is your third choice? A. Perhaps the Spillman & Mooers.

Q. Spillman & Mooers 1,092,870? A. That is right.

Q. Now, you were asked the same question about the Jardine patent, and I think you named several patents. Will you now tell us which of the prior art constructions here relied upon you think comes nearest embodying the improvements in the Jardine patent in suit? A. I would say it came the nearest to the Ricardo patent 1,294,833.

Q. I will ask you the same question about the Maynard patent in suit.

Mr. Bruninga: You ask the witness, without the slot?

Mr. Richey: I am asking you the whole, taking the Maynard piston as you know it, as a piston in structure, mode of operation, and results, which is the single patent in the prior art, which of the devices relied upon as prior art do you think comes nearest embodying that improvement?

A. I would say the Ricardo piston is as close as any of them.

Q. I would ask the same question about the Mooers patent in suit. A. I think Chenard & Walcker patent might come nearer Mooers.

Q. That would be your choice,—Chenard & Walcker? A. Yes.

Q. Now I ask you the same question about the Schmiedeknecht patent in suit. A. (After examining patent) This patent called Pugh.

Q. British patent to Pugh 17,286; that is right, isn't it? A. Yes.

Q. Now, I suppose beyond the patents which you have named as your choice, with each of the patents in suit, you would have to incorporate features from other constructions in order to get nearer the patents in suit, wouldn't you? A. Yes, I should say that not every feature in each patent in suit was covered by any one patent which I might have picked out.

Q. You take the Ricardo construction as shown in the Ricardo patent as Ricardo showed it. That skirt is not flexible, is it? A. No; he designed that to be a rigid structure, I think.

Q. There is no suggestion in his patent that it might be flexible? A. I don't remember any.

Q. As shown, the webs there would not bend or flex laterally, would they? A. No.

Q. And neither would any part of the skirt? A. No; not appreciably, I wouldn't think.

Q. Would you expect that to operate any differently from a trunk type piston? A. Why, it would operate differently in regard to oil consumption perhaps, and perhaps in regard to cooling. As far as flexibility is concerned, I would say that perhaps having a large relief on the side, might allow those slippers to straighten out or flex so as to draw away from the cylinder wall slightly.

Q. You were here and heard Dr. Jeffries testify about the efforts that were made to make that Ricardo piston better than a trunk type piston, weren't you? A. Yes, I was here when he testified about that.

Q. Have you any reason to disagree with what he said about the efforts, the trouble they had with it? A. No, not particularly.

Q. Take the Spillman & Mooers patent you referred to; as shown in the patent, that skirt isn't flexible, is it? A. No.

Q. There is no suggestion in the patent that it might be flexible, is there? A. Not that I remember of.

Q. Did you ever know Mr. Spillman? A. Not personally.

Q. This Herschil-Spillman Company was located not very far from Syracuse, was it? A. Tonawanda, I think.

Q. And you know that Spillman was, during a number of years, working on this piston problem, don't you? A. Yes.

Q. Did you know of this type of piston shown in this Spillman & Moore patent between 1916 and 1920? A. I think so, yes.

Q. That is, at the time that you were making all these, trying out all these things to improve the Franklin piston? A. Why, some time during that time, yes.

Q. Did you know of the Ricardo piston during that time? A. Yes.

Q. Did you know of the Franquist piston during that period? A. Yes.

Q. How about the Schenck piston, did you know about that? A. I didn't know that.

Q. Did the other engineers there at the Franklin Company know about the Spillman & Moore piston at that time, to your knowledge?

Mr. Bruns: I object to that as calling for hearsay.

The Master: Sustained.

Q. Well, did you discuss it with any of them? A. Yes, with some of them.

Q. Did you also discuss the Franquist piston with any of the Franklin engineers during the period you were working on the piston problem? A. Yes, sir.

Q. And the same question about the Ricardo piston? A. Yes, sir.

Q. You said in airplane engines 90 per cent of the heat goes through the piston rings, I believe? A. Approximately.

Q. Did you make any tests yourself to determine that? A. No, I didn't.

Q. Did you take any part in any such tests? A. No, sir.

Q. As a matter of fact that statement is based on what somebody told you, isn't it? A. It is based on what I call general knowledge of the airplane industry,

at least it was general knowledge at the Wright Company.

Q. Well, be that as it may, all you know about it is what you gathered from what somebody said? A. Why, they made tests there in connection with that.

Q. I just want to know whether you know it as the result of your own knowledge or what somebody told you. You don't have to argue or apologize about it. A. Well, I didn't make the tests myself, no.

Q. And your information comes from what they told you? A. Yes.

Q. Now, you said something about the piston rings cocking and letting the gases blow by them. What is the clearance between the piston and the cylinder wall when this occurs? A. Why, a certain amount of blow-by occurs with ordinary operating clearances, say, of .001" per inch of diameter. As the clearance increases the amount of blow-by increases.

Q. When does it become prohibitive, do you know? A. I should say on a $3\frac{1}{4}$ " piston the blow-by would be prohibitive at .012 or .015" clearance, say.

Q. What about a piston that was, say, 4" or 5", say 5" in diameter? A. I should say as the diameter went up the clearance could increase without the blow-by becoming so serious.

Q. When do we reach the limit of what would be tolerated in ordinary use? A. The limit of what—clearance?

Q. Yes, clearance, that causes blow-bys? A. I say in a comparatively small piston, I would say .012 to .015.

Q. Take a piston, say $4\frac{1}{2}$ " in diameter, what clearance could be allowed there, what would be the minimum clearance that would be allowed? A. It depends on what kind of service you are talking about. If you are talking about pleasure car service, ordinary driving, that is one thing; if you are talking about racing, that is another.

Q. Let me ask the question first about pleasure cars? A. A $4\frac{1}{2}$ " piston?

Q. Yes. A. Why, I should say perhaps you might get up to around .015, .018 in a $4\frac{1}{2}$ ".

Q. You think while no greater clearance could be tolerated in a pleasure car, you might tolerate it in a racing car? A. I say that might have an effect, yes.

Q. The conditions of use are very different, aren't they? A. Yes, they are different.

Q. That is, you suffer things in one that you wouldn't in another? A. Yes.

Q. You said there was no necessity of splitting the skirt of the cast iron piston operating in a cast iron cylinder. Was that because the splitting would perform no function? A. No, because the expansion of the metal in the cast iron is considerably less than that of aluminum.

Q. Well, why do you say it is not necessary to split an iron piston? A. Because you don't have so much expansion to contend with in the iron piston as you do in the aluminum.

Q. Therefore there is no need of splitting them? A. It is not as desirable, I would say it is not necessary.

Q. Well, that is due to the fact the slit would not perform any function, would it? A. Well, not with clearances which were apparently satisfactory.

Q. And at what clearances would you say it is necessary to split an iron piston, or that the split would perform any function, say a piston of 3"? A. Well, there again it depends upon the type of service you are going to use the piston in; racing service would be one condition and pleasure car service would be another.

Q. Answer the question with respect to pleasure car. A. I would say if you wanted to get a clearance, in the 3¼" piston, of less than 2 or 3 thousandths, it might be desirable to split the skirt.

Q. Of an iron piston? A. Of an iron piston.

Q. You have known iron pistons to be used with .002" clearance? A. Yes.

Q. Were they split? A. No; they were pretty tight, though, at times.

Q. Now, let's take a 3" piston in a racing car, an iron piston, what would the clearance be before a split performed any function? A. I don't know, Mr. Richey, just how those clearances would be in the racing car, but it is customary in racing cars to give iron pistons or aluminum pistons plenty of clearance.

Q. Well, the greater the clearance the less function would be performed or less opportunity for the split to perform any function, in an iron piston? A. That is true.

Q. Now, take a 4" piston, how much would the clearance have to be for the split to perform any function? A. In a racing car?

Q. Yes. A. Well, I say I don't know how much it would have to be.

Q. You would answer the same about a pleasure car? A. I have had more experience in pleasure cars and I think I might say with a 4" piston in a pleasure car, .003" would work satisfactorily.

Q. If you had as much as .010" there would not be any need of splitting them? A. No.

Q. Because it wouldn't perform any function? A. No.

Q. Did you ever attend any of these automobile races such as Mr. Monckmeier testified about? A. I have been at automobile races. I don't know that I saw any race that he testified about, particular race.

Q. His attention was called to some issue of Motor Age describing certain races. Will you examine that and tell us what was the length of those races, I mean one of the races Monckmeier was in? It gives the Monckmeier races, don't it? A. I have to put on my specs to read that. I haven't examined this sheet at all. I see that Staver of Chicago raced here, is mentioned. I judge that is the race he was in.

Q. I think that. I think that is what he said. A. There don't seem to be any distances given on that sheet. I judge this means the length of one class, or race, here—8 miles, 2995 feet; another class 16 miles, 4998 feet.

Q. Now, at the speed they ran those racing cars, how long would the race last? A. The elapsed time in one race here was 16.29 minutes; another race 16.41 minutes.

Q. Now, were you familiar with the Staver car? A. No, sir.

Q. That passed out before your day, I suppose? A. Apparently; at any rate I wasn't familiar with it.

Q. You spoke of modifying the piston shown in the Rainforth patent by cutting the slot through. That piston would then be about the same as your Exhibit B, wouldn't it? A. Yes, similar to our Exhibit B.

Q. These French patents to Serex, what kind of an engine is that that that is used in? A. That is what is called a piston-valve engine, if that is what you mean.

Q. That is, it has a valve, instead of being a piston to which power is delivered, is it? A. Yes.

Q. Tends to open and close the valve? A. That is right.

Q. Now, isn't it a fact that there is a spring fit in the cylinder? A. Yes, a spring in the sense that that

section of the cylinder is sprung out against the wall of the valve and holds the piston against the side, sealing the port.

Q. And as far as the specification is concerned, there is no question of expansion and contraction of the piston due to differences in temperature, is there? A. Well, I don't know what the specification says now, but I think that difference enters into a piston valve.

Q. As far as you know the specification don't say anything about it? A. No, I don't think so.

Q. Now, the Rainforth patent as illustrated in the patent, was fit with a spring fit, isn't it, that is, to be pushed in and operated at all temperatures, spring out against the cylinder wall? A. Does it say that?

Q. You don't know that without reading the specification? A. I didn't know that.

Q. Is that correct (showing patent to witness)? A. That is right.

Q. So that if that is made out of aluminum and put in an iron cylinder, it would engage in the beginning when the thing was cold and the hotter it got the tighter it would engage? A. Yes, except for what the springs did.

Q. Well, the hotter it got the more the spring? A. The more it would spring.

Q. Therefore the tighter it would be? A. Yes.

Q. Take the Hives British patent, that shows two forms of slotting superposed one upon the other, doesn't it? A. Yes.

Q. Would the piston operate the same and get the same results for each scheme of slotting? A. Not exactly, no.

Q. How would they differ? A. I should say the piston with the slot shown in the dotted line, that is with the horizontal slot at the bottom of the skirt, would be a little stiffer and not as springy as the one where the slot ran all the way through.

Q. Do you think there would be any difference in the clearance at which the two would operate? A. Yes, I think the one with the T-slot running all the way through would run with less clearance than the one having two horizontal slots.

Q. And I suppose the one with the H-slot would be liable to score at the bottom if the clearance was small, would it not? A. I should think so.

Q. And that would be due to the fact the slot wasn't continued through, is that right? A. Yes, it would have a tendency to.

Q. Referring to this Schoengarth patent, as long as the expansion ring is tight, the piston would operate like a trunk type piston, wouldn't it? A. Essentially, yes.

Q. Schoengarth don't say anything about operating this piston shown in his patent in any other conditions than with the ring tight, does he? A. I don't remember that he says in the patent that it could be.

(Recess taken while witness looks up patent.)

A. (Continued) After reading the patent No. 1,174,092, I find in the description, the last paragraph on page 1, as follows: "Obviously more or less slight changes might be made in the form and arrangement of the several parts described without departing from the spirit and scope of my invention, and hence I do not wish to limit myself to the exact construction herein set forth."

Q. That is all you find in there on that subject? A. That is all I find.

Q. He locks the ring in position, doesn't he? A. Yes.

Q. This piston, Exhibit 3-Q, is that in your opinion a faithful reproduction of the piston shown in the Franquist patent 1,153,902? A. Yes, I should say it was approximately.

Q. Well, isn't it a duplicate of the one shown in the patent? A. Yes, as near as I can tell without actually measuring the sections and that sort of thing.

Q. Any differences are immaterial. Referring to this Chenard & Walcker patent, as long as the skirt is unslotted, it is not flexible horizontally, is it? A. It seems to me that piston works much the same as the Franquist in that when relieved at the wrist pin/bosses it can expand along the line of the wrist pin bosses and the skirt becomes oval in section.

Q. My question is, as shown in the patent the skirt is not flexible in the horizontal? A. I say I think it can become oval; it would be flexible to that extent.

Q. Without being split? A. Without being split, yes.

Q. That is, when you speak of the oval operation, you mean that the piston is elliptical in cross section? A. That is right.

Q. And it expands into a circle? A. No, in that case—yes, to some extent, it is elliptical because of the relief around the wrist pin boss.

Q. That was the principle on which you designed your so-called oval piston? A. That is right.

Q. But as you now see the piston it is not shown oval, is it? A. No.

Q. And when you said it might become flexible, you base that upon the presumption it would be changed so as to be oval? A. That is, it would be relieved around the wrist pin bosses.

Q. You contemplate that change in the piston? A. Yes.

Q. Now, going back to my question, let's take the piston as disclosed in the patent. As the piston is shown it would not be flexible horizontally, would it? A. No, not unless it was relieved around the wrist pin boss.

Q. Then as it is shown there would not be any flexing of the parts *d*, would there? A. No.

Q. There is shown in Fig. 2, up above and down below the bosses, some curved lines. Do you understand those to be webs in the horizontal? A. In the head, yes.

Q. No, A-B, it says, is a horizontal view along the line A-B. You must be looking down because you see the bosses, don't you? A. No, I think you are looking in this direction, because you see these webs.

Q. But you see the bosses, don't you? A. Yes.

Q. So you must be looking down from the top? A. I don't think so.

Q. How could you see the bosses looking up in the section along A-B? A. Well, that is right.

Q. That is the section looking down, then, isn't it? A. I guess it is.

Q. Then those lines I referred to, show webs that are below the head? A. What do they show in this view? I don't see any indication of where those are in that view.

Q. Then the two views are inconsistent with each other? A. Well, I don't see it, do you?

Q. Well, I am asking you. You are the expert. What do you understand those lines that I am referring to, show? A. I understand they refer to these ribs up here.

Q. But they are up in the head, and you are looking down in the skirt. A. Wait a minute. I will tell you what that is: these ribs in the head, while they don't show in this view, they run down below this section, so

that these ribs up here actually run out into the head on that radius.

Q. Then you would see them in section, wouldn't you; if they pass from the head to the skirt, the line A-B would cut them and you would see them in section?

A. Not if they pass from the head to the skirt down below this section.

Q. How could they pass? A. From the ring lands.

Q. You don't see any such thing in Fig. 1? A. No, I don't.

Q. Therefore the only explanation you have for it is that the views would be inconsistent with each other?

A. Yes.

Q. You and I have been referring to the line which I mark X; haven't we? A. Yes.

Q. Don't you think those are webs of the piston behind the bosses? A. What do you mean?

Q. Well, connecting the bosses to the inside of the skirt?

The Master: Wouldn't the reading of the patent specification clear that up?

Mr. Richey: No; they don't say.

A. Well, that is kind of a riddle; what he had in mind when he drew that, I don't know.

Q. That is, this disclosure is a riddle to you? A. That particular feature is to me.

Q. Can you tell me how many ribs there are in the head of this Chenard & Walcker patent? A. I should say three; that is two shown in section in Fig. 1, and one shown in full line.

Q. That is just your opinion,—it doesn't show how many, does it? A. That is what it shows to me.

Q. Those ribs would stiffen the member *d-d*? A. Yes.

Q. Referring to the Spillman & Mooers patent again, that piston would be rigid in the horizontal, as shown in the patent, wouldn't it? A. Without the slot, yes.

Q. And there would not be any flexing of the skirt in operation, without the slot, would there? A. I should say not.

Q. Or of the webs? A. No.

Q. Do you find anything in the Spillman & Mooers patent about splitting the skirt? A. No, I don't remember that.

Q. Now, the operation of this piston 3-P would be different from that in the Spillman & Mooers patent, wouldn't it? A. Yes; because this piston is split.

Q. And that makes a new mode of operation? A. It makes it flexible.

Q. Well, it makes it operate differently from what is shown in Spillman & Mooers? A. Yes.

Q. And gives a different result? A. Yes.

Q. Of course if you split the Chenard & Walcker skirt, you would get in the same way a different mode of operation and result from what is shown in the Chenard & Walcker patent? A. Yes.

Q. And the same thing would be true splitting the Ricardo skirt? A. Yes.

Q. This Long patent, 1,872,772, shows no relief at the bosses, does it? A. No.

(Thereupon adjournment taken to 9:30 a.m. following day.)

(Thereupon at 9:30 a.m., Wednesday, February 1, 1933 the hearing was resumed.)

Q. Mr. Stollman, you spoke of bushings having been used in iron pistons. Were they used in the Franklin piston? A. In cast iron, yes.

Q. To what extent were they used in the Franklin? A. I should say quite generally in cast iron pistons.

Q. That was a hollow cylindrical bearing that was put in the boss? A. Yes.

Q. Of what metal was it made? A. Bronze, usually.

Q. What was the purpose of it? A. Well, a sort of cushion; it gave a bearing between the wrist pin and the bearing and not to let the wrist pin bear directly in the cast iron.

Q. Was that standard with the Franklin Company? A. Yes, I think so.

Q. Who else was it standard with? A. My impression was that it was the general practice prior to 1915, most of the time.

Q. But as far as your personal knowledge goes, what other companies besides Franklin? A. I can't designate any particular company. I could look it up for you, if you want.

Q. Now, the aluminum piston didn't have to have that extra bushing in there? A. No.

Q. That was a further advantage of the aluminum piston over the iron piston? A. That is right.

Q. This Exhibit 3-H hasn't any places for the set screw? A. No, that evidently wasn't the bushing type.

Q. That wasn't typical then, of the cast iron pistons that were used? A. Not prior to 1915, in that respect.

Q. This is a later piston? A. I should think so.

Q. When was the use of these bushings discontinued in iron pistons, if it was? A. Why, I think the use of the wrist pin direct in aluminum pistons called attention to the fact that it might be perfectly satisfactory in the cast iron, and it was so used after the aluminum piston more or less demonstrated the construction.

Q. You don't find any such hole in this Exhibit 3-V piston, do you, for the set screws? A. No. Of course you understand that those bushings were held in by other means than set screws.

Q. What other means were used? A. Oh, pinned in; after the bushing was pressed in there a pin was drilled down so that it intersected both the bushing and the piston walls.

Q. Well, that would mean a slot in the piston of some kind? A. No.

Q. In other words, a key? A. No; the bushing would be pressed in, and a pin drilled down through the boss here so that this pin would intersect both the bushing and the wrist pin boss.

Q. You would have a hole in there? A. No, not until after the bushing was put in.

Q. There would be a hole in the boss after the pin was put in? A. Yes, after the pin was put in there would.

Q. That is, wherever the pin was used, there would be some evidence of it on the piston? A. I should think so.

Q. Such as a hole? A. I should think so.

Q. As far as you know, wherever a bushing was used, you would find some kind of hole there, and you don't find any such evidence in Exhibit 3-V? A. No, I don't find such evidence.

Q. This Exhibit 3-V has a chip in one of the bosses. Would a piston having such a chip in it pass inspection? A. No, not in a new piston.

Q. Or if it had a defect in it that was liable to result in such a break, it would not pass inspection, would it? A. No.

Q. Do you find any statement in the Gulick patent in suit to the effect that a bushing or journal was used inside of the boss? A. I don't remember any statement in the patent to that effect.

Q. Well, can we leave it this way: that you read the patent over, and unless you point out something—

Mr. Bruninga: Oh, Mr. Richey, I admit there is no statement at all as to bushing in the Gulick patent structure. You don't need to take this witness' time on that.

Q. Now, the only reference that you find in the Franquist patent which you claim might be taken as referring to a bushing or journal is that at the bottom of the first column, page 1; is that right? A. Yes, I would say that is the one referred to, I think.

Q. Now, referring to the Ebbs patent, I believe you said that that shows a piston for a marine engine? A. That shows the marine type of connectors, I think that was the statement.

Q. You would conclude from that that was intended for a marine engine, would you? A. Perhaps.

Q. Well, you don't know of the use of the marine type of piston or piston having what you call a marine connecting rod arrangement, being used except on a marine engine? A. No; but that patent was taken out in 1902; I wasn't very familiar then with it.

Q. 1899. Of course the marine engines were good sized engines, weren't they? A. Yes; yes, I would say they would be.

Q. There were very few if any gasoline engines used for marine work at that time, weren't there? A. I don't know; I don't think they came into general use at any rate until after.

Q. Of course this application was filed in 1899, see? A. Yes.

Mr. Richey: Now, I ask that this piston be marked for identification Plaintiffs' Exhibit 34. (So marked.)

Q. Will you look at that and say whether or not it has been made in accordance with the drawing of the Ebbs patent?

Mr. Bruninga: The witness is advised to take it apart in order to determine it.

Mr. Richey: Sure he can take it apart, or do anything else he wants to, to look at it.

The Witness: Have you any tools?

Mr. Richey: I haven't any tools.

The Witness: If I had a screw driver and a wrench I could take it apart. Let's say for the purpose of going on that apparently is made after the Ebbs patent, until we have a chance to examine it.

Q. So far as you can see from looking at the outside, it is in accord with the Ebbs patent? A. Yes.

The Master: That is subject to his later examination, with the privilege to modify or supplement his answer if he wishes on the record.

Q. The Ebbs piston such as shown in the drawing of the patent in Exhibit 34, would be rigid in a plane transverse to the direction of the wrist pin, wouldn't it? A. At right angles to the wrist pin?

Q. Yes. A. Yes, sir.

Q. Now that we have gotten this Exhibit 34 apart, will you compare it with the drawing of the Ebbs patent and state whether or not it is a faithful reproduction of the same? A. I should say it was, in principle, the same thing, yes.

Q. Well, do you find any differences between the two? A. No, not just by glancing over it.

Q. Well, look at it carefully and see if you find any differences. A. I don't find any, Mr. Richey.

Q. Now, you have said something about the relation between the flexing of the web at the top in Exhibit 1 and in the Jardine patent, and you said that there would be more flexing in the Jardine patent than in Exhibit 1. That would be a difference in amount or degree, wouldn't it? A. Yes.

Q. The piston of the Anderson patent which you discussed was one of those light iron pistons in which it was undertaken to overcome the heaviness of the cast iron piston then in use, wasn't it? A. That is what he states in his description.

Q. And none of those skeleton iron pistons came into use to any extent, did they? A. Not that I know of.

Q. Is it true that the following patents which you have discussed here show no relief; the Ebbs patent, the Long patent, 1,395,441, the piston Exhibit B, both the Monckmeier pistons, Exhibits 3-V and 3-W, the Van Bever patent, the Vincent patent, the Pugh patent, and the Schoengarth patent? A. I think the wrist pin relief is not shown on any of those stated. (After examining citation.)

Q. You have just examined all the pistons I referred to and you don't find any wrist pin relief? A. The Van Bever and these two (indicating Exhibits 3-V and 3-W) were the only models you called for?

Q. Yes, those were the only two models, and then the patents. A. Yes.

Q. Now, you said in your opinion the nearest patent in the art to Gulick was, first, Ricardo; second, Spillman & Mooers; and third, Chenard & Walcker? A. I think that is right.

Q. Isn't it true, to get the Gulick mode of operation and result, each one of those pistons would have to be modified in some way? A. Yes.

Q. Now, you said that in your opinion the nearest thing in the prior art to each Jardine and the Maynard patents was the Ricardo piston. To get the mode of operation and results of either Jardine or Maynard, the Ricardo piston would have to be modified in some way, wouldn't it? A. Yes.

Q. Now, when you said the Chenard & Walcker was the nearest thing like Ray Day, the Chenard & Walcker piston would have to be modified in some way to get the mode of operation and results realized in the Ray Day piston; that is correct, isn't it? A. Yes.

Q. Now, what piston of the prior art do you consider to be the nearest like Exhibit CCC? A. (After examining same) I should think the Franquist would come as close to that as anything.

Q. What would you say would be the nearest to Exhibit BBB? A. (After examining) There again I should think the Franquist might be as close.

Q. And I believe you said you thought Chenard & Walcker was nearest like the Ray Day? A. (After examining) Yes.

Q. Now, will you answer the same question with respect to Exhibit 3-O? A. (After examining same) I should think the Franquist would apply to that as closely as any.

Q. Would your answer be the same with respect to Exhibit 3-J? A. Yes.

Q. Is it your notion that the piston, Exhibit 3-O, would operate like and get the same results as Exhibit 3-J, assuming the slots cut through 3-J—you have been assuming that all along? A. Yes. Essentially the same, I should say.

Q. And your answer would be the same in comparing 3-O and 3-J with CCC? A. (After examining same) Yes.

Q. Referring to the Long patent 1,489,499, I believe you said the webs 8a would be flexible. A. To a certain degree I should say they would.

Q. And in saying that you assume the piston would be made of the material ordinarily employed in making pistons? A. Yes.

Q. And the same thing would be true of those webs 17, 18, and 19 in the Gulick patent, wouldn't it? A. Yes.

Q. Anybody understanding pistons and skilled in the piston art would know those webs would be flexible if made of the material of which pistons are ordinarily made, wouldn't they? A. Yes, if they were not tied in any way, as shown in this piston.

Q. You wouldn't need anybody to tell that or describe that to you; you could tell that from the drawing, couldn't you? A. I expect I could.

Q. That is, with your knowledge of the piston industry you would know by looking at the drawings that those webs would be flexible if the piston was made of material of which you ordinarily made pistons? A. Yes.

Q. Do you think this Exhibit 20 was a fair reproduction of Figs. 1 and 2 of Gulick? A. (After examining) I should say in general it was made after the Gulick patent.

Q. Do you see any differences between this patent and the Figs. 1 and 2 of the Gulick patent? A. The internal ribbing; there are some slight differences in the ribs on the vertical surfaces. These two ribs near the bottom are not shown on the drawing, but I think in general it was made to follow that design.

Q. The mode of operation and the results of the two would be the same? A. I should think so.

Q. Now, the Gulick piston is flexible at the top of the skirt and at the bottom and all the way along, isn't it? A. Yes.

Q. Will you look again at Exhibit 1? Between the boss and the head on the outside there is a web. That helps to support the boss, doesn't it? A. Yes.

Q. And that goes direct to the head from the boss, the front part of the boss? A. The outside part of the boss.

Q. While you were at the Franklin Company, the pistons that Mr. Long brought to you might have been classified as follows, might they not: A: original type, Magnalite, sand cast, rib on one side only. B: special type with two ribs at right angles to wrist pin, and entire part of the periphery of the piston supported by these ribs only. C: die cast Lynite of the type of A, with the exception that the slots were cast in and supporting

ring at the bottom is omitted. A. In answer to A, I don't know what that rib on one side only refers to. I cannot remember any Long piston that would come under that heading. (After section B is read by reporter) I should judge that referred to what we commonly call the Long piston. (Witness refers to Defendants' Exhibit F.) (After reporter reads section C) I cannot identify that A, and this C refers to A; I can't identify that.

Q. That is, you don't know whether these pistons are correctly identified in the preceding question? A. That is right.

(Short recess taken.)

Q. You don't know or don't remember that that is the way that they have been classified at the Franklin plant? A. I can't remember that classification.

Q. Now, is it a fact, Mr. Stollman, that up until the first part of 1919 the pistons that Mr. Long brought to you were pistons like Exhibit B with certain changes therein with reference to the length of the slots and the ribbing, and that it was not until the first part of 1919 that he came to you with pistons having struts in them, such as shown in Exhibit E, and then he came with a variety of such pistons? A. No, sir, that is not the fact.

Q. You say that is not correct? A. Yes.

Q. Well, isn't it a fact that of the pistons that were submitted to the Franklin Company and tested out, all the pistons up until the first part of 1919 of Mr. Long, were like Exhibit B with the modifications I have mentioned? A. Will you state those modifications?

Q. Like Exhibit B except that the vertical slots were changed in length or were changed in ribbing, but no horizontal slot in any of them? A. No.

Q. You say that is not a correct statement? A. No; because Mr. Long never brought a piston like Exhibit B to us.

Q. Well, the pistons that contained suggestions that were made by Mr. Long that were tried out by the Franklin Company prior to 1919 were such as I have mentioned; that is, like Exhibit B with those variations in it? A. Well, Mr. Long never brought us what we called the Van Bever type of piston, if that is what you mean by your question. My memory is that the piston designated by F is more like Mr. Long's early pistons than it is like B.

Q. By "early pistons" you mean prior to 1919? A. Yes.

Q. That is just your recollection, though? A. That is all.

Q. Didn't he submit to you several forms of pistons having the struts on the inside? A. Yes.

Q. Were any of those like shown in the Long patent 1,395,441 and 1,489,499? A. I don't remember his showing me that particular type, although he might have.

Q. That is, in the patent 1,489,499. But you are not very certain that he did or not? A. No.

Q. And when was it that he showed you pistons like Long patent 1,395,441? A. Some time between his first visit and in say, March, 1919.

Q. But you are not very certain about the date? A. Not the date.

Q. Which one did he show to you first; the one like E or the one shown in the patent 1,395,441; I mean the general form, if there is any distinction between those two; I mean the six-slot piston with the strut. Did he show you that first, or the one shown in patent 1,395,441?

Mr. Bruninga: You mean Exhibit F?

Mr. Richey: Yes, Exhibit F; piston of that general character.

A. I should say that the one shown in this patent might have preceded this Exhibit F.

Q. But you have no very definite recollection of it? A. No.

Q. Did he show you any other pistons than those two? A. Oh, I think likely.

Q. He had a number of different designs? A. Yes.

Q. And showed them to you at different times? A. Yes.

Q. And it is difficult for you to keep straight just which one was shown you first? A. Except that I am very sure that the piston that attracted my attention originally that Mr. Long brought to show us in 1916 had ribs of this type in a general way so that these skirt walls could flex. (Referring to Exhibit F.) That is what interested me and made the deep impression on me in 1916.

Q. You, however, didn't think well enough of that piston in 1916 to have the Franklin Company test it, did you? A. No, not just at that time.

Q. And that was at the time when you were running the pistons like Exhibit B in your cars, wasn't it? A. That is right. I want to call your attention to the fact in that connection that the Franklin Company was then getting ready to manufacture parts for Rolls-Royce en-

gines for the British Government, and our experimental work was more or less interrupted during the years after March, 1916 until after the war, and that was the real reason why we didn't give perhaps more thought and testing to the Long piston at that time.

Q. Well, you didn't think enough of it even to make a record at the Franklin plant, did you? A. No, I don't know as I did; at least I didn't find any.

Q. Do you say that the Franklin Company made no improvements in its cars between 1916 and 1919? A. No, I didn't say that.

Q. You kept on developing the car, didn't you? A. To some extent; the experimental work was curtailed very materially.

Q. Did you make any change in your piston at that time? A. We used substantially that Van Bever type piston in that time.

Q. Didn't you try out other pistons in that time similar to those I named yesterday? A. Yes, perhaps, although I can't say we did very much experimental work on pistons between 1916 and 1919.

Q. Do you remember where Mr. Long's place of business was in 1916? A. I think either Hannibal or Quincy.

Q. Do you know which one? A. No, I don't.

Q. What year was it that the Franklin used an expanding ring in the groove in the bottom of the piston?

A. I don't think they used it in production.

Q. Well, you said they used it in replacement, A. For use in service.

Q. What year was that? A. Well, I would say that was 1917, perhaps.

Q. Either the latter part of 1916 or the first part of 1917? A. I should think so.

(Short recess taken.)

Q. Now, isn't it a fact that weekly, if not daily, during 1917 and 1918, pistons were being tested in the laboratory of the Franklin Automobile Company? A. Perhaps to some extent.

Q. Well, isn't my statement about a correct one? A. As I have said before, we curtailed our experimental work very materially.

Q. I know you said that. Now answer my question. No use saying that over again. A. I couldn't say they were being tested daily.

Q. Or weekly? A. Or even weekly.

Q. Well, they were tested monthly during those years? A. Perhaps so.

Q. And during that time you were testing virtually all of the pistons that I named yesterday, and you said had been tried out at Franklin? A. I don't remember just what we were testing then, Mr. Richey.

Q. Do you remember any piston that was tested in 1917? A. Oh, we did a good deal of work on that Van Bever type piston, I remember that.

Q. That is Exhibit B with the ring in it? A. Yes, and without the ring.

Q. Let's take the first part, take January, 1917, isn't it a fact pistons were being tested on January 20 and January 27, 1917? A. I don't know.

Q. Isn't it a fact they were being tested on February 3rd, February 10th, February 17th and February 24th, 1917? A. I couldn't testify as to those dates.

Q. You can't say whether that is right or wrong? A. No.

Q. Now, isn't it a fact that tests—those dates I have named are typical of the activity in the Franklin testing on pistons during 1917 and 1918? A. I couldn't say as to that.

Q. What was your position there during 1917 and 1918? A. Assistant chief engineer.

Q. Did you have charge of the testing laboratory? A. It came under my supervision, yes.

Q. And you were in close contact with it? A. Yes.

Q. Take those two years, 1917 and 1918, what is your best recollection as to how many times pistons were tested at the Franklin Company during those years? A. A good many times.

Q. And a good many different kinds of pistons were tested? A. Yes, but I want to state again our activities centered on the Van Bever piston during those days.

Q. That is a change in the Van Bever piston? A. Yes.

Q. That is, you changed it and then tested it? A. Yes.

Q. And what was the purpose of all those changes? A. To get it to work better.

Q. Wasn't the Wainwright piston tested in June, 1917, in the laboratory at the Franklin? A. It may have been.

Q. You don't remember? A. No, not as to that particular piston.

Q. Well, it was tested a number of times during that period, wasn't it? A. It was tested during the period, yes.

Q. That is, during 1917 and '18? A. Yes.

Q. And of course that wasn't the Van Bever piston, was it? A. No.

Q. You also tested cast iron pistons during that period? A. Well, the Wainwright was a cast iron piston.

Q. You also tested composite pistons during that period, didn't you? A. I don't know whether we tested them during that period or not. We tested them sometime.

Q. You tested the Zethyr piston during that period, didn't you? A. I think so.

Q. And that wasn't the Van Bever piston? A. No.

Q. Didn't you during that period test pistons having aluminum heads and cast iron skirts? A. I don't remember.

Q. If you did that wouldn't be the Van Bever piston? A. No.

Mr. Richey: That is all.

RE-DIRECT EXAMINATION by Mr. Bruninga.

Q. When you said Exhibit 3-Q was a duplicate of that shown in the Franquist patent, did you have reference to the specific dimensions? A. No, sir, the general structure.

Q. When you said that the Spillman & Mooers structure would have to be modified in order to operate as the Gulick patent structure, what did you have in mind, what modification? A. Well, of course it would have to be slotted. You are referring to the Spillman & Mooers as shown in their patent?

Q. Yes. A. And the point where the ribs are leading down from the head to the skirt would have to be raised to be more nearly central with the wrist pin boss.

Q. You have now in mind the specific structure shown in the Gulick patent, the web?

Mr. Richey: Object to that as leading.

A. Yes.

The Master: It may stand.

Q. When you said the Ricardo piston would have to be modified to have the mode of operation of the Jardine patent, what did you have in mind as the principal modi-

fication? A. The Ricardo piston is not slotted and the slot would have to be added to the Ricardo piston to make it similar to the Jardine.

Q. I believe you said that with reference to the Maynard patent the closest reference was the Ricardo piston. Did you have in mind any slotting?

Mr. Richey: Object to that as leading. Let him say what he had in mind.

The Master: He has answered it.

Q. Well, the Ricardo doesn't show the slotting. What did you have in mind, then? A. I meant the Ricardo piston slotted would resemble the Maynard patent.

Q. And when you said on cross examination in your opinion the Chenard & Walcker approached the Mooers patent in suit, what feature did you have in mind? A. As I remember it, in the patent to Chenard & Walcker it says that the ribs running from the head to the skirt or to the wrist pin bosses can be arranged in any way which would suitably give the desired results. If the ribs of the Chenard & Walcker were brought out to the wall of the piston, we would have very much the same result as in the Mooers with these ribs removed.

Q. How about the Franquist patent in that connection? A. The same thing would apply.

Q. Now, you said that the Ricardo piston was a rigid structure. Why do you say that? A. Because of the fact that it is not slotted and the rib and the skirt form a box section which is essentially rigid.

Q. What work would be required to make it flexible? A. The slotting of the skirt and the change in dimension of the ribs, perhaps.

Q. Well, refer to that patent, the Ricardo patent, and state what dimension of ribs would be required? A. The ribs shown at C in Fig. 3 might have to be thinned up some, and the skirt about at the point referred to in Fig. 3 by the letter E would have to be slotted.

Q. You are referring now to the specific dimensions as shown in the patent drawings, is that right? A. There are no dimensions shown in the patent drawings, sir, but the general view would indicate the size of the sections.

Q. Has it been your experience that Patent Office drawings are made to scale to indicate thicknesses of parts? A. I don't think necessarily, no.

Q. I believe you said on cross examination that you knew about the Ricardo patent structure at the time you were in the Franklin Company. Was that before or after the Long piston came into use? A. Before the Long piston came into use.

Q. That you knew about the Ricardo structure? A. Yes.

Q. Do you know about what year that was? A. I should say in 1915 or '16, along in there.

Q. Who submitted to you the Ricardo structure? A. Nobody submitted the Ricardo structure, but I saw it in publications, and general knowledge of the art.

Q. You didn't see an actual piston, then, did you? A. No, not that I remember.

Q. Having reference to the Serex French patent, it was brought up in cross examination that this is not a power piston. What function is performed by a piston valve with reference to necessity for sealing? A. A valve, from necessity, must seal the ports of the engine and be tight under various operating temperatures.

Q. At what speed, so far as revolutions per minute, does this piston valve in an internal combustion engine operate with reference to the power piston? A. With a four-cycle engine, I should say it would run half the speed of the piston in the engine.

Q. Is it desirable that there be slap of the piston valve? A. No, the valve must be quiet as well as the piston of the cylinder.

Q. With reference to the Hives British patent, Mr. Richey called your attention to the H slot that would be formed if the lower dotted slot were used instead of the slot a' going clear to the end of the piston, and I believe you said there would be liability of scoring; is that true if the slot a' extends to the end as shown in full lines? A. No, I would say that would help that considerably.

Q. Even with an H-slot what would you say if the piston of the Hives patent is oval, that is, with the small diameter along the line of the wrist pin axis? A. If the piston was ground oval, of course that would help the action materially, and also if the portions over the horizontal slot at A and the dotted slot at the bottom were relieved, that would help the action, too.

Q. I want to call your attention to a photostat of the March 12, 1914 number of The Automobile, pages 602, 603 and 604, marked for identification as Defendants' Exhibit 4-J. I want you to refer to Fig. 1 and read the part on page 603 under the sub-heading "Prismatic pis-

ton surface" before I ask you any more questions. A. (Witness complies.)

Q. Do you understand that? A. Yes, sir.

Q. What kind of a piston will be produced in that operation described on page 603, to which I have referred, is performed? A. First, they put a piston in the engine and run it and obtain evidences of where the piston is tight. Then they relieve the spots where they are tight and put the piston back and run it again, perhaps a little harder the second time. They again take the piston out and examine it, relieve it again where it shows tight, and continue that performance until they get a piston which operates to their satisfaction. Then they take this piston and use it as a pattern in a copying lathe or copying grinder, and produce other pistons similar to the piston which was run satisfactorily in the engine.

Q. Where will the piston show wear in such an operation? A. Well, it depends on the design of the piston, I should say.

Q. Well, a straight trunk piston, for instance as illustrated in Fig. 2? A. One of the places where it would show wear would be around the end of the wrist pin bosses.

Q. When you get through with such an operation, what will be the cross section of the piston? A. I should say it would probably be slightly oval with its center line through the wrist pin bosses.

Q. With its shortest diameter where? A. Parallel to the wrist pin.

Q. What relation has such a piston to the oval piston which you have been examined about that was used by the Franklin Company? A. In general the same result was obtained by grinding the piston oval as they show in that article.

Q. How did you proceed to grind them oval at the Franklin? A. We did it with our grinder, which was tooled up to grind the oval section.

Q. How did you obtain that oval section; did you compute it or obtain it experimentally? A. We obtained it experimentally by grinding off the sides of the piston walls until we got it ground down far enough.

Q. Now, the March, 1914 issue of The Automobile, photostats of pages 558, 559 and 560 of which I have marked for identification as Defendants' Exhibit 4-K, contains an illustration, Figs. 1 to 4, and contains the following statement: "What is now being done to effect these effects of uneven convection of heat? In some

cases the whole piston is made slightly oval by flattening it over the whole length of both sides. If this is found to be unnecessary, a place is flattened around each piston pin hub. If the pistons are not only turned but also ground, this flattening may be done conveniently by simply mounting them with the hubs sprung slightly apart, and when the hubs spring back after the grinding is done, the piston surface near them will be found to recede somewhat from the circular form." What will be the cross section of such a piston if it undergoes such an operation? A. If you take this cast iron piston, for instance,—

Q. Exhibit 3-H. A. —and expand it along the diameter of the wrist pin, put that expanded piston in a grinder and grind it so that the circle is round, after it had been expanded, then take it out of the grinder and take this expander block away, the piston will have become oval, with the shortest diameter parallel to the wrist pin.

Q. Do you understand English? A. Yes.

Q. Is it your idea that the expression "extremely rigid" means the same as "very flexible"? A. I should not think so, no.

Q. As a matter of fact, those expressions are as wide apart as the poles, aren't they? A. Diametrically opposed, I should say.

Q. In any trunk piston or in any piston, as for instance in the Gulick patent, having webs such as 17 and 18 along the line of thrust, what have you to say about the pressure on those webs, in what direction is it as far as thrust pressure is concerned, when operating in a cylinder? A. With the piston slotted as shown in the patent?

Q. Slotted or unslotted. What direction is the line of thrust? A. I should say the line of thrust in this case would be out parallel to the direction of the web.

Q. The Gulick patent, page 1, line 16, *et seq.*, states: "Another object of the invention is to rigidly support the piston pin bosses of a piston from the piston walls against mechanical load thrust from the connecting rod." What would that require as far as rigidity is concerned, in what direction would your rigidity be? A. The rigidity would have to be in this plane of the web as shown in Fig. 2, web 19, to be rigid.

Q. Does the statement, as far as I have read it, convey to your mind a rigid structure? A. As far as you have read, yes.

Mr. Brunninga: I want to offer in evidence at this point the file wrapper and contents of the Gulick patent in suit, as Defendants' Exhibit 4-L.

Q. Considering now the structure of the Gulick patent as shown in the drawing, how would you construe the following statement: "It will be seen that in addition to providing a piston with a split skirt, the above described construction also provides extremely rigid connection between the piston pin bosses and the guide portion of the piston, which construction may be used either with or without the split skirt and separated head. The arrangement of the supporting flanges 17 between the ends of the piston pin bosses and the connection of these flanges with the piston skirt provide a particularly strong support for the bosses." I am reading from Exhibit 4-L, page 4, a paragraph of the original application as filed. Will you tell me whether that conveys to your mind that the webs 17 and 18 were designed to be very flexible or extremely rigid?

Mr. Richey: Objected to as leading.

The Master: Same ruling.

A. He describes a very rigid section between the wrist pin bosses and the skirt of the piston, designated by 17 and 18 in Fig. 4.

Q. Would that convey to your mind that the structure was intended to be very flexible? A. No, sir, I should say that he intended that it should be rigid.

Q. But if the structure is split as shown in the Gulick patent, you understand that the structure would flex; in other words the slot would close? A. Yes, sir.

Q. What have you to say about the Chenard & Walcker and the Spillman & Mooers structure, if split between the wrist pin bosses? A. They are flexible also.

Q. Is that due to any special construction or inherent flexibility? A. Inherent flexibility in that type of construction shown.

Q. And the Gulick patent structure as shown will flex if the webs will flex, and if the slot will close? A. Yes.

Q. Can you tell me whether or not the Spillman & Mooers patent structure would have the same or different action as far as closing of the slot is concerned? A. The same, I would say.

Mr. Richey: You mean if you split the Spillman & Mooers?

The Witness: Yea, that is what he said.

Q. That is what you understood; is that right? A. Yes.

Q. In considering the Gulick patent you had reference to the Ricardo structure. Can you tell me whether the addition of the circumferential part outside of the webs 18 has any effect upon the flexibility of the structure? A. I would say not.

Q. Well, as far as—I mean as far as the flexing of the webs is concerned, these are continuous arcs on the outside of the webs 17 and 18? A. I thought you said slot. If those were continuous arcs, of course that would stiffen the web materially.

Q. More or less than in the Ricardo structure? A. More.

Q. In other words what flexibility must you rely upon in the Gulick structure, if there is any flexibility, flexibility of webs or flexibility of skirt? A. Flexibility of webs.

Q. And must you rely upon the flexibility of the webs in the Gulick structure? A. Yes.

Q. How about the flexibility of the part opposite the slot 21? A. That would flex somewhat; quite a little.

Q. You notice that in Exhibit 20 there is no wrist pin, is there? A. No.

Q. If the wrist pin were placed in that structure, do you think it would affect the flexibility? A. Probably stiffen it.

Q. If the wrist pin was left out of Exhibit 3-P, would that affect the flexibility? A. Make it more flexible.

Q. Now, referring to the Chenard & Walker patent structure, the parts which are shown in Fig. 2 and which seem to curve from the webs "d" to the skirt of the piston are not described at all. You have said that on direct examination? A. Yes.

Q. You don't know, then, what they indicate? A. No.

Q. But what do you find in the Ray Day piston Exhibit 8, with reference to inside webs? A. The webs are shown as being from the head to the wrist pin boss.

Q. But I mean the inside circumferential webs or ribs? A. There are ribs shown in the interior of the skirt, these ribs here which are strengthening ribs.

Q. In fact there are three, one at the top, one intermediate, and one at the end; is that right? A. Three, yes.

Q. And those two, the one at the top and the one in the middle, connect right with the wrist pin boss? A. That is right.

Q. Do you find that flexible? A. Yes.

Q. What are the circumferential parts, the inwardly extending circumferential parts, in Figs. 1 and 2 of the Gulick patent; one of them is a short distance above the bottom of the skirt, and the other is about in the line of the wrist pin bosses, and still another one above the wrist pin bosses; what do you take those to be? A. They are circumferential ribs on the inside of the piston.

Q. What is the part at the bottom, extending inward? A. That is another rib at the bottom of the piston.

Q. And what do you find at the top, at about the line indicated by 15? A. Line indicated by 15 is a groove backed up by a rib on the inside of the piston.

Q. But what forms the groove 15, I mean is it cut in there or does the skirt extend straight up? A. Cut in.

Q. Now, what do those surrounding parts do to the skirt, do they make it more flexible or stiffer? A. Those circumferential ribs stiffen it.

Q. There are grooves on the outside of the piston opposite those annular ribs, we might call them, is that right? A. Yes.

Q. Do you know what the function of those grooves is? A. I should say perhaps carry oil on the surface of the piston.

Q. You said on cross examination, I believe, that as shown in the drawing a piston of the Chenard & Walcker patent was not oval. You didn't measure it, did you? A. No.

Q. What do you take this statement to mean in the translation: "It is known that pistons of this kind cause the cylinders to wear into an oval shape, and in order to try to eliminate this inconvenience they are given quite a complex section by machining them or reproducing on copying lathes in order that upon expansion they may closely fit the walls of the cylinders." What do you understand that to mean as to the practice? A. I should say, in general, that the piston was relieved on the sides opposite the end of the wrist pin boss.

Q. That is, that is what that statement refers to? A. Yes.

Q. Do you know, are you familiar with tin cans? A. Yes.

Q. Are you familiar with the idea of rolling beads in tin cans? A. Yes.

Q. What are those beads put in there for? A. They stiffen the side walls of the can.

Q. Can you tell me what the inevitable result, if any, of splitting the Spillman & Mooers and the Chenard & Walcker piston will be? A. It will make them more flexible.

Q. Do you know whether bushings are ever used in aluminum pistons? A. We thought at first that we would have to bush a boss of an aluminum piston, but we found that not necessary. I don't know of any case where bushed wrist pin bosses are used on aluminum pistons.

Q. Referring to Exhibit 3-V and the chip on the wrist pin boss, does that look to you that it might have been done when the piston was originally made or can you tell from the looks of that whether it was in there before that piston was ever used? A. My guess would be that the piston wasn't used in that condition.

Q. What makes you think so? A. I don't think a man would use a piston like that, he would be afraid that wrist pin boss would crack open.

Q. But can you tell by looking at it? A. You can't tell by looking at it whether it was used or not, but it would be my thought he wouldn't want to use it like that.

Q. Mr. Richey asked you on cross examination whether the flexibility of Exhibit 1 and the Jardine patent structure was one of degree, and I believe you answered yes. What did you have in mind when you made that answer, that the flexibility was the same? A. No, it was comparable in degree.

Q. And how in degree? A. One might be more flexible than another in degree.

Q. Well, the webs 25 of the Jardine patent are described as flexible. Do you find flexible webs at the top in Exhibit 1? A. No; and Exhibit 1 is stiffer at the top than the Jardine.

Q. Well, as far as the piston structure at the bottom is concerned, how does the flexibility of Exhibit 1 compare, for instance, with the flexibility of Exhibit B, that which you call the Van Bever piston, as far as flexibility of the bottom is concerned, assuming the slots to go up the same distance? A. Well, there being more slots in the Van Bever, I should say it may be a little more flexible than Exhibit 1.

Q. If there was only one slot? A. If there was only one, it would be the same.

Q. Now, I want to call your attention to Exhibit 3-W, the Monckmeier aluminum piston. Does that have a relief in the region of the wrist pin bosses? A. There is a relief above the wrist pin boss all the way around the piston. I don't see any indication that this piston was relieved around the end of the boss.

Q. Well, look at the Pugh British patent 17,256. What have you to say as to the presence or absence of a relief there in the region of the wrist pin bosses, Fig. 3, in the region, say, of "c" to "g"? A. There seems to be an offset section at the end of the wrist pin bosses, shown in both Fig. 2 and Fig. 3.

Q. What will that produce? A. That will give a clearance at the end of the wrist pin.

Q. Referring now to Exhibit 1, one of Defendants' pistons, Mr. Richey has examined you about the web on the inside going from the wrist pin boss to the head of the piston. In what way does that web distinguish from the webs as employed in the Franquist piston prior to 1915? A. Well, this web seems to be the equivalent to moving the side of the trunk piston in on the wrist pin boss.

Q. No, I mean the web in a vertical plane extending across the head of the piston and down to the wrist pin bosses? A. Now, what was the question in regard to that?

Q. In what way does that compare with the web as used in pistons prior to 1915 about which you have testified? A. Oh, I should say a rib like that was employed at that time.

Q. In what way does it differentiate from the web shown in Heldt's book, deposition Exhibit M? A. The rib in Exhibit M is the same as that shown in Exhibit 1.

Q. How about the little webs or ribs on the outside of Exhibit 1, going from the head of the piston to the wrist pin boss, what is the purpose of that web or rib? A. That is to stiffen the wrist pin boss, help support it in the head.

Q. You said this Gulick piston, Exhibit 20, was flexible at both the top and bottom. What have you to say with reference to Exhibit 3-P, particularly assuming that the wrist pin is out of that piston? A. That is also flexible.

Q. Is it flexible even with the wrist pin in? A. Yes.

Q. Is that wrist pin in tight? A. Yes, very tight, tighter than actual practice.

Q. Why did you call Exhibit B a Van Bever piston? A. We didn't at the time it was made, but after we got into production, or some time while we were getting in production, we discovered that Van Bever had a patent, a man by the name of Van Bever had a patent on it.

Q. Did you ever pay him a royalty? A. No, we didn't, that I know of.

Q. Did you know about the Van Bever patent before you started in production of that Exhibit B? A. Well, perhaps before we started in production, but not while, the first part of the time we were doing experimental work on it.

Q. Did you know about the Van Bever patent or any Van Bever piston before you put those slots in Exhibit B? A. No, I didn't.

Q. On cross examination Mr. Richey examined you with reference to the Rainforth patent, and asked you the similarity of the Van Bever structure or Exhibit B, and I don't know just what you testified to as to that, but can you tell me whether or not the surrounding relief A with the slots extending in both reliefs, have any effect upon the Rainforth piston? A. I should say that relief was what made that piston workable. The slots extending into the relief allow the side walls shown at D to expand and contract against the cylinder walls.

Q. Now, I believe you also testified on cross examination that when such a piston as in the Rainforth patent is forced into a cylinder so that it will spring in, that upon heating of the piston it will get tighter in the cylinder? A. Yes, that is right.

Q. What have you to say about any slotted piston when it is put into the cylinder as a piston heats up? A. That will function, the piston expands and goes out against the cylinder wall, and the slots allow it to contract or to function against the cylinder wall without undue pressure.

Q. Is it your opinion, as you read the Rainforth patent, that Mr. Rainforth intended that these slots close when the piston is cold? A. No, I don't think they close when the piston is cold.

Q. Now, Mr. Richey cross examined you with reference to the Herschil-Spillman Company. Did you read The Horseless Age in 1914? A. Yes.

Mr. Bruninga: I mark for identification page 555 of the April 8, 1914, issue of The Horseless Age, as Defendants' Exhibit 4-M.

Q. Can you tell me whether you recognize it? A. I think likely I saw that Herschil piston—the Spillman piston described in that Horseless Age at that time.

Q. With reference to the Chenard & Walcker piston, will you tell me whether you ever heard of the Premier-Weidely engine of the Premier-Weidely car? A. Yes, I have heard of it.

Q. Do you know whether that automobile was in use in 1913 and '14? A. I couldn't testify as to the date of use, but I should say around about that time.

Q. Did you ever see the piston in that car? A. No, sir.

Mr. Bruninga: I want to have marked for identification as Defendants' Exhibit 4-N pages 1080 and 1081 of the December 24, 1913 issue of The Horseless Age; also as Defendants' Exhibit 4-O, pages 85 and 86 of the March 12, 1914 issue of The Automobile Engineer.

(Thereupon noon recess was taken.)

(Thereupon, at 1:30 P. M. the hearing was resumed.)

Q. Mr. Stellman, in discussing this piston valve, the French patent, I guess you remember what I referred to those Serex patents, can you tell me whether those valves would be subject to any pressure, gas pressure? A. Yes, against the side walls of the valve, the gas explosion pressures would bear against the side walls of the valve.

Q. Is that the same pressure as the pressure that is applied to the power piston? A. It is.

Q. Now, in discussing the Ebbs patent, Mr. Richey examined you about, whether marine engines were in use in 1899, the engines being of the internal combustion type. My examination of you was with reference to the type of connecting-rod. Did you have anything else in mind when I examined you, except the difference between the locomotive type and the marine type connection? A. No; that is what I had in mind. I didn't even refer it to gasoline engines.

Q. Now, when you said that the Spillman & Mooers and the Chenard & Walcker structures were not flexible, what have you to say as to the Galick patent structure, if

there is no slot in it? A. I should say that was a rigid construction without the slot.

Q. Well, I mean of course the vertical slots? A. Yes.

Q. How do the Spillman & Mooers and Chenard & Waleker and Gulick structures then compare, if none of them have that vertical slot? A. They are all rigid constructions without the vertical slot.

Q. You were cross examined with reference to Exhibit 3-H. Can you tell me in what respect that piston differs from cast iron pistons used as early as the beginning of 1915? A. One of the differences I had in mind was that this piston is not bushed in the wrist pin hole; while it was clearly common practice in 1915 to bush the wrist pin holes for the piston pin.

Q. How about the internal webs? A. This piston is of rather a lighter construction than was used in 1915 in general practice, I should think, and perhaps has more webs on that account.

Q. How about the reliefs? A. I should say those reliefs were in general use in 1915.

Q. How about the oil groove at the bottom of the ring lands? A. Oil grooves were used in 1915 similar to that shown in this piston.

Mr. Bruninga: That is all.

RE-CROSS EXAMINATION by Mr. Richey.

Q. This Ebbs construction, you say, was for a marine engine? A. I said it had the marine type connecting-rod.

Q. That was for a steam engine, wasn't it? A. I don't know. I have forgotten what the patent said, if it said anything about that.

Q. Did you know that construction to be used on a gasoline engine? A. Not specifically, I couldn't say that I know of any.

Q. That is, I mean the construction with relation to the wrist pin that you said was of a marine construction. Did you ever know that to be used on a gasoline engine?

A. I think it was used on gasoline engines; used in marine motors, too; I can't state any particular motor.

Q. You don't know of any case of your own knowledge? A. Not of my own knowledge.

The Master: The Ebbs patent says pistons for gas or other motors.

Mr. Richey: I am asking about the use of it. People say a lot of things.

Q. Now, you have pointed out the difference between the Ricardo and Jardine, in considering the construction shown in evidence at Figs. 6 and 7 of Jardine. There is also the difference that the Jardine webs are moved out and carried on the edge of the head, isn't that so? A. That is, as compared with the Ricardo construction?

Q. Yes; as shown in the Ricardo patent. A. Yes, those are moved out.

Q. Now, you spoke of running pistons and noting where they rubbed and then cutting that away, as being a practice that was employed to fit the piston to the cylinder. That practice you employed along in between 1915 and 1920, didn't you? A. Yes.

Q. And other engineers employed it, too? A. I would say so.

Q. And that practice was employed in an effort to get the aluminum trunk pistons to work in the cylinder without slapping and scoring? A. Yes.

Q. Now, you said that that would get down to the oval construction; that is correct, is it? A. I said it might.

Q. Well, notwithstanding that, in 1922 you filed an application for a patent upon an oval construction, didn't you? A. Yes.

Q. Well, I thought you said that in this cut and try business, or cut and rub off scheme that was employed back in 1915 to 1920, that that would result in an oval piston? A. I said it might result in an oval piston.

Q. Notwithstanding that, you, in 1922, made application for a patent on an oval piston? A. That is right.

Q. And at that time you of course made an oath that you considered yourself to be the inventor of this oval piston? A. Yes.

Q. You did that in view of the fact that you now claim that the rubbing and the cutting away would have resulted in an oval piston? A. I don't see that there is a crime about that, Mr. Richey.

Q. I don't say it is a crime. But as a matter of fact, that is reconciled by the fact that when you filed this application for a patent, you embodied in your claims more than the oval shape, didn't you? A. Yes.

Q. That is, it was combined with other features? A. Yes.

Q. Now, do you remember what other features? I show you a copy of your patent 1,557,625 that was issued from that application we have been talking about? A. I

think one of the features we had in mind was shown in lines 55 to 65.

Q. Just what was the feature? A. It says: "In operation the piston is placed in a cylinder with concentric portions of the pistons"—

Q. I don't mean to read it; just state what it was. A. It really covers the fact that the piston expands in the direction of the wrist pin and draws the piston in on the thrust surfaces.

Q. That is what you really did in that patent, was to claim the combination of elements of which the oval construction was one? A. Yes.

Q. And those elements themselves were old, weren't they? A. Perhaps so.

Q. And what you consider to be patentable in the piston was this combination of old elements which had been combined for the first time? A. I should think so.

Q. Then you do think that in this piston art the combination of old elements into a new combination is good enough to patent? A. I consider that that combination was.

Q. Now, you were asked about the meanings of words "flexible" and "rigidity" and things of that kind. As a matter of fact you, as an engineer, compare these pistons by what they do and how they do it rather than by the words somebody uses, don't you? A. Eventually, compare results.

Q. And that is the way you work in the engineering practice? A. Yes.

Q. And you were asked about this article by Mr. Gunn. There is a piston shown here marked—look at Fig. 3. That is a piston that had a liquid chamber around it, wasn't it? A. I don't know whether that was a liquid or just an air space.

Q. That is an aluminum piston in which they tried to solve the problem of putting some kind of cooling system in the piston? A. I should think so.

Q. That never made any progress, did it? A. Not that I know of.

Q. Do you know when that was tried out? A. No, sir.

Q. Over on the next page, Fig. 5, is that piston a Zephyr piston? A. Essentially I should say.

Q. That was what you tried out at the Franklin Company and didn't get anywhere? A. Yes.

Q. Take Fig. 7 of this Gunn article of Exhibit 4-G. That piston shown in Fig. 7 is of the general construction as shown in Exhibit 24, isn't it? A. Yes, I should say it was.

Q. And as far as you know, that piston was not successful? A. No.

Q. You don't know when it was first tried out? A. No, sir.

Q. Now, look at the piston shown in Fig. 8. That differs from the so-called Long piston shown in, for instance, Exhibit E, in that on one side the boss is cut away from the web; that is correct, isn't it? A. Yes.

Q. So that is not the Long piston as you used it? A. No, sir.

Q. Do you know whether the Long piston was ever tried out like that, or rather such a piston as shown in Fig. 8 was ever tried out? A. I don't think we tried it, Mr. Richey.

Q. You don't know whether it was tried out or not. Now, take the one shown in Fig. 11 of this article: that has got some kind of insulating material in the top? A. I should judge so.

Q. Mineral wool, or something of that kind? A. Yes.

Q. Do you know if that system was ever tried out? A. No.

Q. This never came into use, did it? A. No.

Q. So far as you know, a piston like that shown in Fig. 8 never came into use? A. Not just in that form.

Mr. Brunnaga: Are you going to give the court a copy of this Stellman patent 1,557,625?

Mr. Richey: You give him a copy.

Mr. Brunnaga: Of course I want to offer that in evidence with the other patents, not as a new exhibit. I offer it in evidence in the book form.

Q. Mr. Stellman, the main function of the piston is to transmit power, isn't that correct? A. Yes, and to seal the explosion gases.

Q. Well, it has got to transmit power, whether it seals or not. The primary function is transmission of power? A. I should say so.

Q. That is pretty onerous work, transmitting that power from the explosion to the connecting-rod, isn't it? A. I should judge so by the amount of work it does.

Q. It puts a heavy burden on the piston? A. Yes.

Q. And the prime consideration is that the piston shall transmit that power and do that rough work without going to pieces or breaking up in the cylinder? A. That is right.

Q. What is the force of the blows on the top of the piston? A. Why, I should say there is a pressure there as high, in 1920, as high as 350 pounds per square inch.

Q. And how often did that blow come on the piston? A. Once every other revolution of the engine.

Q. How many revolutions per minute, would you say, in 1920? A. Oh, say they ran 24 to 26 hundred revolutions per minute.

Q. How many blows per minute would that be, roughly? A. That would be twelve or thirteen hundred blows per minute.

Q. And the direction of the piston was reversed how many times per minute under those circumstances? A. Twice every revolution.

Q. Now, that blow tends not only to drive the piston down but to drive it over against one wall, doesn't it? A. Yes.

Q. One wall of the cylinder. So when you consider giving a piston flexibility, lightening it and controlling the heat in it, all the time you have got to keep in mind that the first consideration is that the piston shall stand the blows and do this work; that is correct, isn't it? A. That is right.

Q. And any combination that you form of a piston that would result in flexibility and the accomplishment of these other features, has got to take into consideration first that it does that work and withstands those blows? A. That is right.

Q. And if you, in trying to make a piston flexible or make it transmit heat in the proper way, or lighten it, you sacrifice that first consideration, that is, doing the work, why, your piston would not be of any practical importance, would it? A. That is right.

Q. Now, with a racing car the supreme consideration is development of power, isn't it? A. Yes.

Q. And as far as preventing slap and those things, that is all of negligible consideration, isn't it? A. To a degree, yes.

Q. Now, isn't it a fact that the racing car drivers have never used these split skirt pistons as far as you know? A. I don't know of a case right off hand where they used split skirt pistons, except this one that has been used.

Q. Well, except what you have heard about this Monckmeier piston? A. Yes.

Q. But except for that, you have not known of any racing driver ever using split skirt pistons? A. No; but I will have to admit that my experience with racing pistons has not been very great.

Q. Well, as far as your knowledge goes, you don't know of any? A. That is right.

Q. These racing car drivers are at all times experimenting with their apparatus, trying this and trying that, to get another mile of speed out of it, aren't they? A. I judge so.

Q. And that has been your observation? A. Yes.

Q. They are at all times trying something and then going on to something else? A. They work all the time over their cars to get them better and better.

Q. And since aluminum pistons have come in, the racing car drivers haven't used them split to your knowledge? A. Not to my knowledge.

Mr. Richey: That is all.

Re-Direct Examination by Mr. Branninga.

Q. Just one question: Mr. Richey has talked about the pressure blow on a piston, on a working piston in an engine. Can you tell me whether or not that same pressure blow also comes in a piston valve in that same engine? A. Yes, the same pressures as act on the valve act on the head of the piston.

Mr. Branninga: That is all.

(At this point the testimony of D'Vorsky, Record pages 328 to 343 was taken.)

Mr. Branninga: I offer in evidence Defendants' Exhibit CCC, which is a piston; EEE, section of Spillman & Mooers; FFF, Long piston; 3-G, cross section of Exhibit 1; 3-H, a cast iron piston; 3-I, a clamping device; 3-J, the Ford piston; 3-K, the Silv-O-Lite Piston; 3-L, circular of Silv-O-Lite; 3-O, another piston; 3-P, split Spillman & Mooers; 3-Q, Franquist piston; 3-R, half-section Galick piston; 3-S, the Automobile Engineer of October, 1918; 3-T, complete Galick piston; 3-U, photostat of letter from McCoy to Harness; 3-V, Monckmeier cast iron piston; 3-W, Monckmeier aluminum piston; 3-V', Kant Skare piston; 4-A, diagram produced by Stellman; 4-B, photostat produced by Stellman; Ebbs patent with locomotive connection.

Mr. Richey: We object to that as immaterial.

Mr. Bruninga: 4-G, the Gunn article; 4-H, book of patents; 4-I, royalty report with drawing attached; 4-J, photostat of March 12, 1914, issue of The Automobile; 4-K, The Automobile, issue of March 5, 1914; 4-L, Galick File Wrapper and contents; 4-M, photostat The Horseless Age, April 8, 1914; 4-N, The Horseless Age, page 1081, December 24, 1913 issue; 4-O, photostat The Automobile Journal, March 12, 1914; 4-P, a postal card, Monckmeier automobile; 4-Q, sketch produced by D'Vorsky; 4-R, photostat, Anamosa Journal. With reference to this Automobile Engineer, Defendants' Exhibit 4-S, the Automobile Engineer of October, 1918, I would like to substitute photostat of pages 274, 5, 6, 7 and 8, in order not to make the record so bulky.

The Master: It will be so ordered.

Mr. Richey: We agree to that. We will repeat our objections to these exhibits made during the taking of the testimony, except as to such as were not set up in the answer, because they weren't set up in the answer, and to get the thing behind me, I will offer this piston which was offered for identification as Defendants' Exhibit AAA, as Plaintiffs' Exhibit 41.

Mr. Bruninga: As 4-I1, File Wrapper and contents of Mooers patent in suit; 4-I2, File Wrapper and contents of the Jardine patent in suit; 4-I3, File Wrapper and contents of the Schmiedeknecht patent in suit; 4-I4, File Wrapper and contents of Maynard patent in suit; 5-C, page 250, December 28, 1921 issue of Motor World.

Mr. Richey: That has not been up before, has it?

Mr. Bruninga: No.

Mr. Richey: All right; I think it is immaterial.

Mr. Bruninga: 5-D, photostat of page 133 Automobile Trade Journal, cited by the Patent Office.

Mr. Richey: That has a date on here April, 1916. What makes you think that is the right date?

Mr. Bruninga: I got it from the Patent Office. We can check that up very easily.

Mr. Richey: Well, subject to correction, I make the objection.

Mr. Bruninga: 5-E, photostat, page 504 of the Automobile Engineer of December, 1920.

Mr. Richey: On all of these publications I object to the statements of fact in there as hearsay.

Mr. Bruninga: 5-F1, photostat of pages 3 and 5, Motor Age, of August 24, 1911.

Mr. Richey: I object to it as immaterial. Not properly identified; and the facts in it are hearsay and not set up in the answer.

Mr. Bruninga: You know we have a stipulation about photostats of publications?

Mr. Richey: Not that an immaterial one shall become material.

Mr. Bruninga: 5-F2, Motor Age, August 31, 1911, photostat of pages 10, 12, and 15.

Mr. Richey: Same objection.

The Master: Same ruling.

Mr. Bruninga: 5-F3, photostat The Automobile, October 12, 1911, page 643.

Mr. Richey: I make the same objection to this.

Mr. Bruninga: 5-F4, Motor Age, October 12, 1911, photostat page 10.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F5, The Automobile, October 12, 1911, photostat page 687.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F6, The Automobile, November 16, 1911, page 853.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F7, Motor Age, November 16, 1911, page 15.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F8, Motor Age, December 14, 1911, pages 4 and 7.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F9, Motor Age, October 16, 1913, photostat page 21.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F10, Motor Age, December 4, 1913, page 24.

Mr. Richey: I make the same objection.

Mr. Bruninga: 5-F11, photograph the Peoria Star, September 27, 1913, one page.

Mr. Richey: Same objection.

Mr. Bruninga: 5-F12, photograph page Peoria Star, July 5, 1914.

Mr. Richey: Same objection.

Mr. Bruninga: 5G, certified copy of the incorporation papers of Staver Motor Car Company.

Mr. Richey: What is the purpose of putting in these 5F-1 to 5F-12?

Mr. Bruninga: To support Mr. Monckmeier, showing the dates of those races by publication.

Mr. Richey: In other words, you intend to rely upon the statements in these publications that there were races on those dates?

Mr. Bruninga: Oh, I want to support Mr. Monckmeier's statement that there were races and that he was in races on those dates.

Mr. Richey: And you depend on these papers because they say they were?

Mr. Bruninga: No; I depend on Mr. Monckmeier also.

Mr. Richey: I object to all this as immaterial, and move that it be stricken out. He is just relying on the statements in the papers and publications that there were races on those dates, and there are a dozen—

The Master: Same ruling; they are in. I will receive them.

Mr. Bruninga: 5-G, certificate from the Secretary of State of Illinois with reference to Staver Motor Car Company. 5H-1, photostat, decision Law Examiner in Interference Hartog versus Pomeroy, 45,351.

Mr. Richey: I object to this 5H-1 as immaterial. It doesn't relate to any of the patents in suit, and relates probably to the Hartog and Pomeroy patents, or one of them, and they were brought in here without any pleading in the answer with respect to them.

Mr. Bruninga: Does your Honor want to hear from me at all?

The Master: I think not. I will receive it over the objection, and you may have an exception.

Mr. Richey: I am going to object to this decision further on the ground that it is not accompanied by the motion and pleadings to which it relates and contains certain statements of fact that were apparently adopted from those pleadings, that would be incompetent as secondary.

The Master: Same ruling.

Mr. Bruninga: 5H-2, copy of decision of Examiner of Interferences in the Hartog-Pomeroy interference. 5H-3, copy of the decision of the Board of Appeals in that interference.

Mr. Richey: I make the same objection.

The Master: Same ruling. Is this the same case as is reported in the 42 F. (2d)?

Mr. Richey: No; those don't even relate to the patents in suit. A typical illustration of lumbering the record up with a lot of immaterial stuff.

Mr. Bruninga: You know what I am going to put these in for.

Mr. Richey: Oh, you have some nebulous theories about the thing.

The Master: Well, we will receive them, and consider the theories when they are advanced.

Mr. Bruninga: Now, I would like to substitute for the books of account Exhibit V-1 to V-7, the deposition exhibits, photostats of pertinent pages that we have quoted from, and I have the exhibits here and I will produce them in court, but I believe counsel will agree I can substitute photostats for the pertinent pages that counsel for plaintiff has had, and then they can examine the books at any time.

Mr. Richey: What pages, so that we can check the pages?

Mr. Bruninga: The pages were given to Mr. McCoy.

The Master: The pages were referred to in the testimony.

Mr. McCoy: Just as referred to in the testimony; is that the understanding?

Mr. Bruninga: Yes, those that we have submitted here copies of.

Mr. McCoy: Oh, yes, in the deposition testimony, except they are objected to as immaterial and irrelevant to any matter before the court.

The Master: Same ruling; they may stand.

Mr. Bruninga: 5-L. I also want to offer in evidence a copy of the bill of complaint in the case of The Cleveland Trust Company and the Chrysler Corporation versus The Simmons Manufacturing Company, Equity No. 3510, Sterling Corporation being also named as party-defendant, in the District Court of the United States for the Eastern Division of the Northern District of Ohio.

Mr. Richey: Is that the only thing you have left?

Mr. Bruninga: Those are the only exhibits I have left. There will also be a letter from Anna Landon Duke, who kept the record books V-1 and

V-7, and counsel seems to be satisfied with the lady's letter, and I will offer that in evidence as Defendants' Exhibit 5-J.

There is one witness, your Honor, of whom I would like to take his deposition, and possibly some one to support him. I just got in touch with him lately and he lives in Ironwood, Michigan. I may be able to get him down as far as Chicago; but he doesn't want to come here. Now, the man's name is Schoengarth, and it comes up in connection with that Schoengarth patent 1,174,092. Now, it is not the usual case where I might have taken his deposition beforehand. There was a motion for further particulars in each of these cases, and the particular construction which was relied upon as an infringement was Exhibit 1. During the time that Dr. Jeffries testified, the patents were expanded and expanded until now they seemingly cover, according to plaintiffs' contention, a structure like Exhibit CCC. Our contention is that that CCC is practically the same as that illustrated in the Schoengarth patent, and we want to take his deposition as to the use of that structure. During the prosecution of the application of the Gulick patent, this patent was cited, and together with a number of others, then an affidavit was filed by Gulick going back of, way back to 1914. Now, that was sufficient for the patent; but there is another question involved here; and that is whether perhaps Mr. Schoengarth had this thing in public use more than two years prior to the filing date of the Gulick application, which is November, 1915, and of course that matter was not investigated by the Patent Office at all. I am informed that he did have it in public use more than two years before the filing of the Gulick application, and that becomes pertinent in this case now on account of plaintiffs' position that the Gulick patent is broad enough to cover a structure like Exhibit CCC. The question is not one of validity of the patent so much as it is the question of whether, first, Gulick could expand his claims to an extent sufficient to cover a structure like that, and, second, whether this court will expand the claims sufficiently broad to cover a structure already in the prior art and barred by the two years' use.

Right after the position taken by counsel in this case, I proceeded to investigate the matter further,

and I got in touch, finally got in touch with Mr. Schoengarth by long distance telephone, had a number of conversations with him, and I understand from him, that he actually had this in use, and I believe we are entitled to take the deposition of Mr. Schoengarth and one or two additional witnesses right in that vicinity, that he thinks he has there.

The Master: Is there any objection to this?

Mr. Richey: Yes, sir; our position is, in the first place, the order for the Master does not authorize the master to grant leave to take depositions at this stage of the proceeding. If your Honor will remember, there is a statute that provides for the taking of depositions in the federal courts, and as I remember the statutes, they allow the taking of depositions between the joinder of issue and the trial. The Supreme Court has announced a certain rule setting times for taking depositions, and authorizing the courts to grant leave to take depositions outside of the rule. So I think my Brother must go to the court. Beyond that there was a stipulation entered into in each of these cases between the parties that depositions might be taken until fifteen days before the cause was to be set for hearing. Now, as far as the presence of Exhibits BBB, CCC, and JJJ are concerned in this case, they have been interjected by the other side. This Schoengarth patent, though long known, has not been pleaded in the answer. There is no excuse for the delay, therefore, and his statement of what he intends to prove would not establish a public use in view of the Barbed Wire Case and other cases.

(Thereupon further argument was had.)

The Master: My judgment would be that the defendants would be entitled to take that testimony, if they cannot get that witness here.

Mr. Richey: Well, is your case completed, except for that?

Mr. Bruninga: My case is closed except for that.

Mr. Richey: Can you give us the names of the witnesses now?

Mr. Bruninga: I can give you Mr. Schoengarth's. I have those names on my tab at the hotel.

Mr. Richey: It all relates to that one thing?

Mr. Bruninga: It all relates to that one thing.

They are all around Ironwood, and the order will be limited to those.

Mr. Richey: Then we will have the right to take any depositions to answer it?

The Master: Oh, yes, certainly.

Mr. Richey: I presume your Honor grants an exception to your ruling?

The Master: Oh, certainly.

Mr. Richey: We will reserve the right to move to strike the depositions out.

The Master: Yes, you may have the right.

Mr. Richey: Now about the expense of taking these depositions. Is your Honor going to make any order about that? Do we have to go to the expense under the circumstances?

Mr. Bruninga: I went to the expense myself to take all those depositions.

Mr. Richey: Considering the fact that he is making this application at this late date—

The Master: I cannot make any order except such as is subject to the final order of the court, and any cost of depositions may be taxed as costs of the case, to be finally determined by the order of the decree.

Mr. Richey: All right; I guess we are ready to proceed.